Greenhouse Automation

PROJECT REPORT

SUBMITTED IN THE PARTIAL FULFILLMENT FOR THE REQUIREMENT OF THE AWARD OF DIPLOMA IN COMPUTER ENGINEERING

SUBMITTED BY

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(2019-2020)

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Of term EVEN 2017 of Computer Engineering department students have submitted their Project report on **Greenhouse Automation.** During academic session 2018-2019 as a part of project work prescribed by Government Polytechnic, Nagpur for the partial fulfillment of the requirement of diploma in Computer Engineering, Sixth Semester . The project work is the record of students own work and is completely satisfactory.

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CANDIDATE'S DECLARATION

We hereby certify that the work which is being presented in the project report entitled **Greenhouse Automation** by us in partial fulfillment of the requirement for the award of diploma in Computer Engineering, Govt. Polytechnic, Nagpur submitted to department of Computer Engineering is record of our own work carried out during Academic session 2019-20 (Even 2019) guided by **Mr. S. A. Khatri**

Signature and Name of the students

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We are extremely thankful to **Mr. D. S. Kulkarni**, Principal, for providing us infrastructural facilities work in, without which this work would not have been possible.

Signature and Name of the students

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Abstract

This work aims at developing an entirely automated plant/crop watering system. The main motivation behind this system is to conserve the wastage of water and to effectively manage the amount of watering of the plants. It also aims at reducing human labor, effort and errors due to human negligence. It uses solar panels to provide power to the system at daytime. Solar energy is used to run the system during daytime and charge the batteries to operate at night. It uses moisture sensors to sense the level of moisture in the soil. When the moisture content of the soil goes below a certain limit for a plant/crop, the pump system is triggered and the plant/crop is watered. The plants are watered efficiently till the desired value is reached and the pump is switched off automatically.

Contents

1 INTRODUCTION

1.1 Introduction

Greenhouses are a great way to make plants available all year round, however their effectiveness depends on the weather conditions which vary constantly. Although we are able to predict the weather to a high degree, the predictions are not always 100% accurate and so planning ahead would not help all of the time. Some of the problems that can occur are frost, condensation and overheating which can lead to the plants becoming damaged. Automated systems that are used to control environments e.g. a fish tank that needs to maintain a specific water temperature, are able to cope with sudden, unpredicted changes. Being able to cope with the changing weather would reduce the number of damaged plants. The purpose of this project is to address the fact that there are currently no automated systems specifically designed for controlling the everyday garden greenhouse. This chapter highlights the aims and objectives of the project as well as what greenhouse automation systems exist in industry and what automation system are available in the home.

1.2 Motivation

The Buller greenhouse was built in the 1960's to house a variety of plants used for teaching and research purposes. The building itself comprises of nine rooms that each have their own unique climate conditions. This allows some very unique plants to be kept in the greenhouse from a wide range of locations. The main concern for each of these rooms is that they stay within a proper temperature range. In the summer months this is primarily done by manually opening and closing windows. This requires staff to come in on the weekends if the outside temperature gets too high. The goal was to implement a system that allows remote monitoring and control to help reduce the amount of time staff needs to be present in the greenhouse. The scope of the project was to produce a working prototype monitoring and control system for one room of the Buller greenhouse. This system can be accessed remotely using a web server on any internet connected device. This project could be easily expanded for use in all of the rooms in the greenhouse so that each room could be automated. This report will demonstrate that a fully automated greenhouse could be realized using our design and an expanded budget.

1.3 Objectives of Greenhouse

There are four major objectives for the project:

1. Take Temperature, Humidity, Light and Soil Moisture readings
2. Display past and present sensor readings to the user
3. Be able to update the settings for multiple plants
4. Act upon sensor readings that deviate from the defined range

1.4 Brief Description of System

1.4.1 Temperature

The temperature of the environment is extremely important for plants as it affects multiple growing factors: the rates of photosynthesis and respiration, germination, flowering and ultimately crop quality. Extreme temperatures can negatively impact plant productivity so maintaining the temperature in a greenhouse is crucial. Each plant also has its own specific temperature range so being able to adjust the settings in the greenhouse is equally as important.

1.4.2 Humidity

Humidity is the measure of how much moisture is present in the air. When plants transpire, water vapour along with molecules of gas are released from the statoma on the underside of the leaves, increasing the humidity.
A high humidity can be fatal to plants if it is not monitored, as a build-up of moisture on plants 'promotes the germination of fungal pathogen spores such as Botrytis and powdery mildew'. It is therefore important to make sure that air is circulating through the greenhouse to reduce the water vapour around the plants.

1.4.3 Light

Plants use the energy from light for photosynthesis and so without light, plants would not be able to grow. Different plant needs different amounts of light but if a plant receives too little light then problems will start occurring, such as

- Stems will be leggy or stretched out
- Leaves turn yellow
- Leaves are too small
- Leave or stems are spindly

- Brown edges or tips on leaves
- Lower leaves dry up
- Variegated leaves lose their variegation

1.4.4 Soil Moisture

Water is another key element in photosynthesis. Plants absorb water through their roots where it then travels up the stem and into the leaves where photosynthesis occurs. It is therefore important to monitor the moisture levels in the soil, making sure that there is enough water for the plant but also taking care not to over saturate the soil, as this could cause the roots to rot.

1.4.5 The Choice of Microcontroller

The microcontroller is the key component of the project as it will control the sensors and transducers that monitor the environment. It will also need a way to connect to the internet and store sensor readings and plant settings.
d Initial research into the possible devices needed for this project showed that the microcontroller would need around 7 analogue pins and 9 digital pins. This needed to be taken into account when selecting the board. However, these values were likely to change as the project progressed so the board needed to be able

to cope with that. There were numerous microcontrollers available and we choose Arduino Uno for the Project.

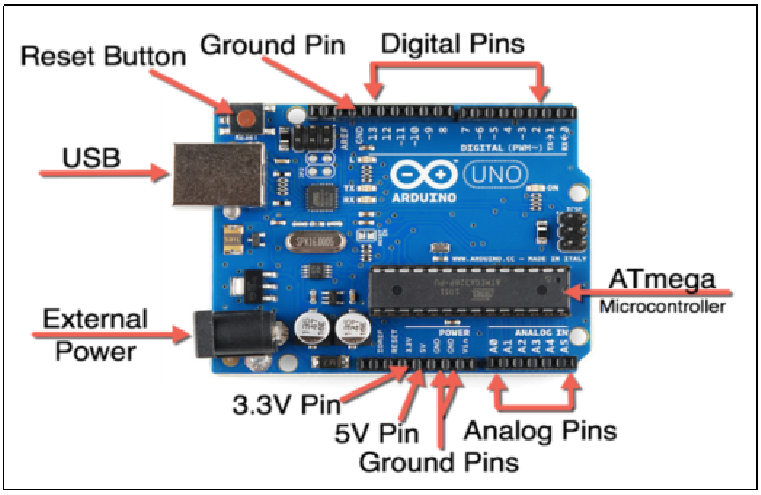


Figure 1: Arduino Board

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

2 Literature Survey

Keerthi, Dr.G.N.Kodandaramaiah has explained GSM (Global System for Mobile), cloud computing and Internet of things (IoT) based electronic system, its design and implementation for International Journal of Recent Trends in Engineering & Research (IJRTER) Volume 03, Issue 01; January - 2017 [ISSN: 2455-1457] @IJRTER-2016, All Rights Reserved 191 sensing the climatic parameters in the greenhouse. The system meets the actual agricultural production requirements and also monitors a variety of environmental parameters in greenhouse effectively. For demonstrating the proposed system devices such as temperature sensor, light sensor, relative humidity sensor and soil moisture sensor are integrated. The parameters collected by a network of sensors are being logged and stored online using cloud computing and Internet of Things (IoT) together called as Cloud IoT. Irrespective of the owner's presence onsite, the procedure provides the owner with the details online. In modern agriculture greenhouse cultivation represents a very important role. A fully automated greenhouse control systems along with improved monitoring system provides obvious benefits such as labor saving, but far more importantly, it enables improved quality of production and information gathering that will make difference between earning a profit and suffering substantial losses. In recent times projects are on a rise even in urban areas in unique forms. Technological progress makes the agricultural sector grow high, which here the Cloud IoT makes. The information stored about us and the way we live our daily lives will be dramatically changed by IoT. As the computer is connected with the Internet this cloud computing is free to use anytime and anywhere to provide the updates this monitoring system percepts different parameters inside the greenhouse using sensors, GSM, and cloud.

B.VidyaSagarhas specified about architecture of a greenhouse monitoring system consisting of a set of sensor nodes and a control unit that communicates with each sensor node and gathers local information and makes necessary decisions about the physical environment. The monitoring and GSM systems are developed for the use in green house applications in this project, where real time data of climate conditions and other environmental properties are sensed and control decisions are taken by monitoring system and they are modified by the automation system and sends SMS that what operation is performed by them to user. The ambiguous applications of WSNs are immense. These networks gathers, stores and shares sensed data among them self's and to external node.

Human labor plays major role in the monitoring farm and plants in the agricultural field. In the greenhouse this will provide enormous foundation for future growth and future development of their plants However, as the size of farming areas increases, this type of manual practice increases time consumption and cost of the labor. This system uses wireless sensor network, Global System for Mobile Communication (GSM) and short message service (SMS) to carry out data from the green house with sensors which directly notify the farmers on their mobile phone. This type of practice removes the use of wires and improved the old method of gathering data in the farming areas. This technology has seen to be suitable for these modern days. Moreover, this paper focuses on the monitoring and automation system in greenhouse which has capability of controlling With the wide improvement of wireless and GSM technology the system may cost a little but it works with more perfections. The system can also be implemented with the help of many technologies but this technology is more reliable, easy to implement, works properly and easy to operate.

3 System Analysis and Design

3.1 System Analysis

3.1.1 Problem Definition

Irrigation of plants is usually a very time-consuming activity to be done in a reasonable amount of time it requires a large amount of human resources. Traditionally, all the steps were executed by humans. Nowadays, some system use technology to reduce the number of workers or the time required to water the plants. With such system, the control is very limited, and many resources are still wasted.

Water is one of these resource that are used excessively. Mass irrigation is one method used to water the plants. This method represents massive losses since the amount is one method used to water the plants. This method represents massive losses since the amount of water given is in excess of plant's needs.

This contemporary perception of water is that of a free, renewable resource that can be used in abundance. But is not true In addition to the excess cost of water, labor is becoming more and more expensive. As a result, if no effort is invested in optimizing these resources, there will be more money involved in the same process. Technology is probably a solution to reduce costs and prevent loss of resources. In the case of traditional irrigation system water saving is not considered. Since, the water is irrigated directly in the land, plants under go high stress from variation in soil moisture, therefore plant appearance is reduced. The absence of automatic controlling of the system result in improper water control system. The major reason for these limitations is the growth of population which is increasing at a faster rate.

3.1.2 Objectives

1. To ensure continuous and sufficient supply of water to plant.
2. To avoid wastage of water.
3. To reduce the processing time and schedule..
4. To minimize losses through wastage and damages.
5. To keep flow of water under control through scheduling.
6. To minimize losses through wastage and damages.
7. To automate the irrigation system.

3.1.3 Feasibility Study

Technical feasibility

(a) A brief description of the business to assess more possible factors which could affect the study.

(b) The part of the business being examined.

(c) The human and economic factor.

(d) The possible solutions to the problem.

The technical feasibility assessment is focused on gaining an understanding of the present technical resources of the system and their applicability to the expected needs of the proposed system. **Time feasibility** The project development was planned to reach designing phase by the end of the semester which gives a duration of six months. This was enough time to develop a working version of the end product and the software. **Financial feasibility**

(a) Total estimated cost of the project

(b) Financing of the project in terms of its capital structure.

(c) Existing investment by the promoter in any other business.

(d) Projected cash flow and profitability.

3.1.4 Requirement Analysis

Hardware Requirements

1. Plywood for making model.
2. Water Pump(DC servo motor)
3. Moisture sensor
4. Jump Wires
5. Double Relay
6. Motor driver
7. Single relay
8. Laptop

Software Requirements

- Arduino IDE software.
- Arduino programming.

3.2 Design

3.2.1 Proposed Design

In the field section, various sensors are deployed in the field like temperature sensor, moisture sensor and PIR sensor. The data collected from these sensors are connected to the microcontroller through RS232. In control section, the received data is verified with the threshold values. If the data exceeds the threshold value the buzzer is switched ON and the LED starts to blink. This alarm is sent as a message to the farmer and automatically the power is switched OFF after sensing. The values are generated in the web page and the farmer gets the detailed description of the values. In manual mode, the user has to switch ON and OFF the microcontroller by pressing the button in the Android Application developed.

Other parameters like the temperature, humidity, moisture and the PIR sensors shows the threshold value and the water level sensor is used just to indicate the level of water inside a tank or the water resource.

HARDWARE USED

ATmega 328 microcontroller

ATmega-328 is basically an Advanced Virtual RISC (AVR) micro-controller. It supports the data up to eight (8) bits. ATmega-328 has 32KB internal builtin memory. This micro-controller has a lot of other characteristics.

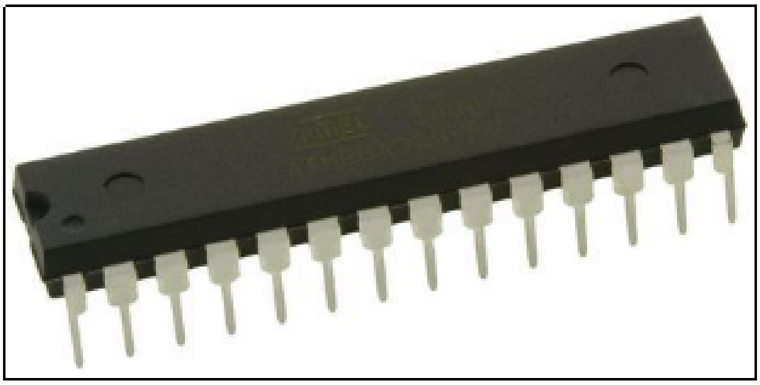


Figure 2: ATmega 328 microcontroller

ATmega 328 has 1KB Electrically Erasable Programmable Read Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). Other characteristics will be explained later. ATmega 328 has several different features which make it the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc. ATmega-328 is mostly used in Arduino. The further details about ATmega 328 will be given later in this section.

SOIL MOISTURE SENSOR

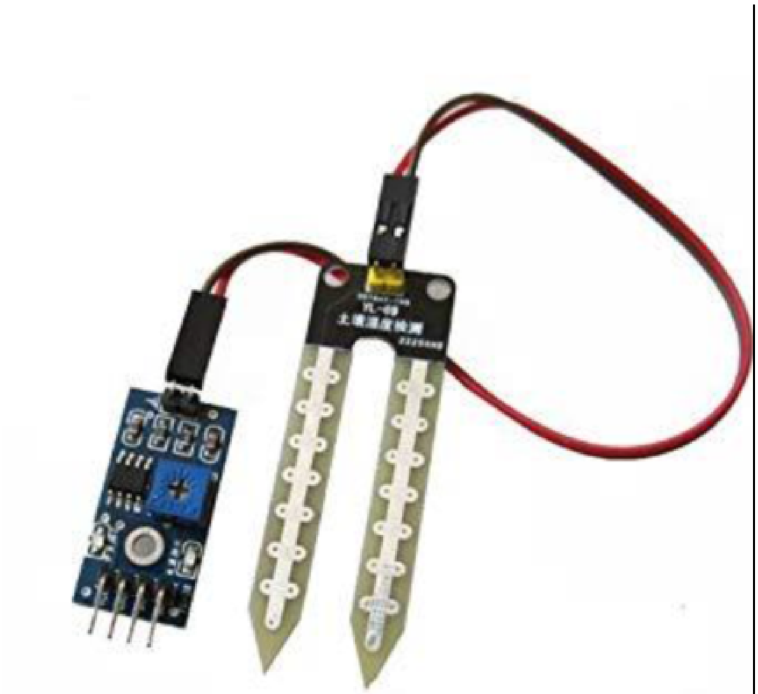


Figure 3: Soil Moisture Sensor

Soil moisture sensor is a sensor which senses the moisture content of the soil. The sensor has both the analog and the digital output. The digital output is fixed and the analog output threshold can be varied. It works on the principle of open and short circuit. The output is high or low indicated by the LED. When the soil is dry, the current will not pass through it and so it will act as open circuit. Hence the output is said to be maximum. When the soil is wet, the current will pass from one terminal to the other and the circuit is said to be short and the output will be zero. The sensor is platinum coated to make the efficiency high. The range of sensing is also high. It is anti-rust and so the sensor has long life which will afford the farmer at a minimum cost.

TEMPERATURE SENSOR

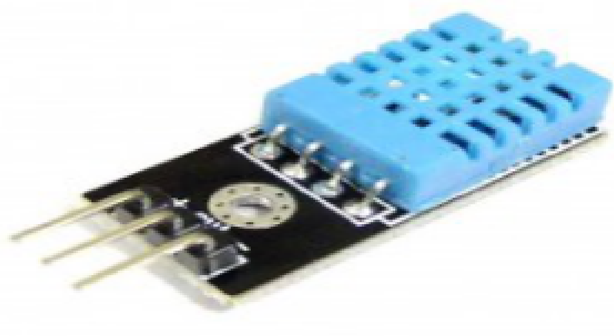


Figure 4: DHT11 Sensor

The **DHT11**is a commonly used **Temperature and humidity sensor.** The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0 ° C to 50 °C and humidity from 20% to 90% with an accuracy of ±1° C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.

SOFTWARE USED

IDE(Integrated Development Environment)

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

3.2.2 Detailed Design

The controller was required to monitor the temperature, humidity, light and soil moisture levels as these are four of the most important environmental factors during plant growth. The design step for this was to think about what can be done to control these factors. It was also necessary to think about how the web application would interact with the sketch so that it could display the current sensor values.

3.2.2.1 Dealing with Temperature

All plants have a temperature range that they grow best in, which is why we see different plants at different times of the year. An automated greenhouse should be able to maintain a specific temperature range for however long is necessary.

If the temperature exceeds the maximum allowed temperature, the greenhouse needs cooling down in some way. In industry this would usually be achieved by opening vents or turning on fans, letting air circulate through the greenhouse. When the temperature becomes too low, the greenhouse would need to be heated up and all vents and fans would be closed and powered down. For the project, two CPU fans can be used represent an intake fan and an extractor fan and can be turned on when the temperature is too high. If the temperature becomes too low an LED will turn on as it is not feasible to connect a heater for safety reasons.

3.2.2.2 Dealing with Humidity

The most effective way to maintain a low humidity is to keep the greenhouse dry, which can be done by warming up plants and keeping air circulating through it. If the humidity is too low however, then moisture needs to be added to the air. This can be achieved by spraying water around the plants. 18

The CPU fans mentioned in 3.4.1.1 'Dealing with Temperature' can be used to reduce the humidity if it becomes too high. If the humidity becomes too low another LED will be used to indicate it instead of spraying water, as using water around the board could damage it.

3.2.2.3 Dealing with Light

Lighting is generally only an issue at night but is easily rectified by simply turning on one or multiple lights, depending on the greenhouse size. It also needs remembering that 'plants cannot get too much light, but they can get too much of the heat energy that comes with the light', so care needs to be taken with the type of bulbs being used and what the current temperature of the greenhouse is. A larger white LED will turn on during periods of low light to represent this.

3.2.2.4 Dealing with Soil Moisture

Plants absorb water through their roots for use in photosynthesis. This, along with other factors, such as a high temperature, will dry out the soil. Maintaining the soil moisture content is therefore essential in order for plants to continue to grow healthily and can be achieved in different ways. One of which would be to sprinkle water on the soil after a certain time period. There are soil moisture sensors available for the Arduino so monitoring the soil moisture content can be done using one of these. Indicating when the levels become too high or too low will again be done using LEDs. There are pumps available for the Arduino, and examples of this being done, but was no time to carry this out in this project.

4 SYSTEM IMPLEMENTATION AND TESTING

4.1 Setting Environment

We used the an Arduino software for the system Implementation

4.1.1 Arduino Software (IDE)

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

4.1.2 Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

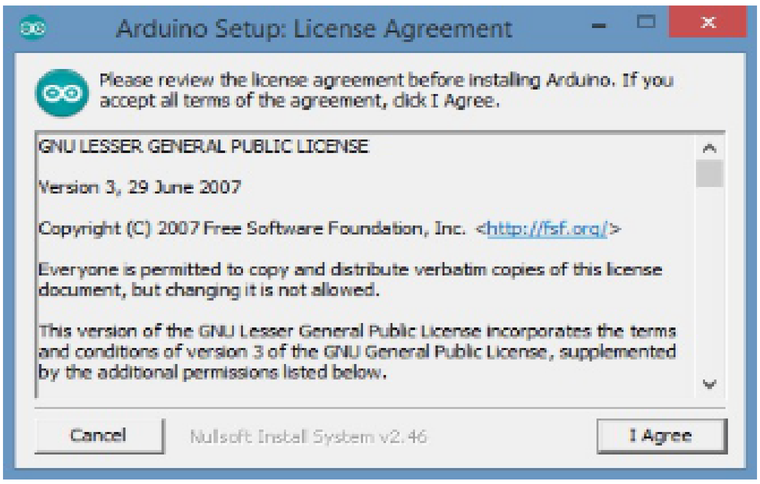
4.1.3 Installing the Arduino IDE

1. Visit http://www.arduino.cc/en/main/software to download the latest Arduino IDE version for your computer's operating system. There are versions for Windows, Mac, and Linux systems. At the download page, click on the "Windows Installer" option for the easiest installation.

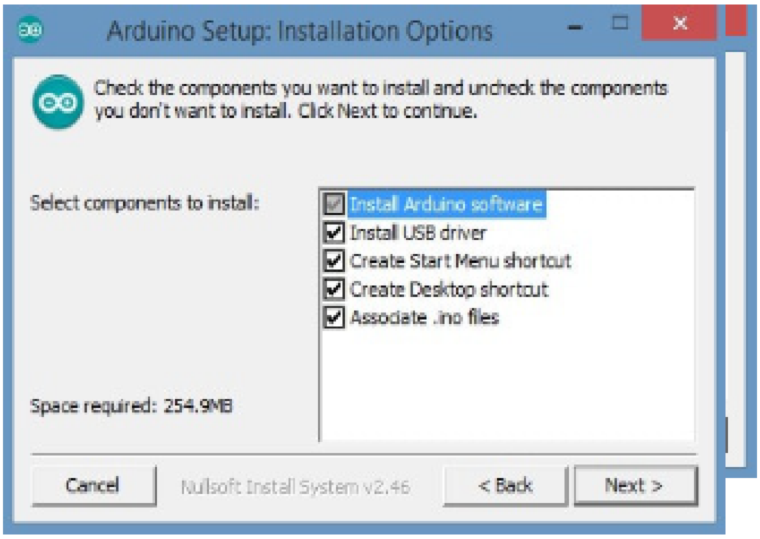
2. Save the .exe file to your hard drive.

3. Open the .exe file.

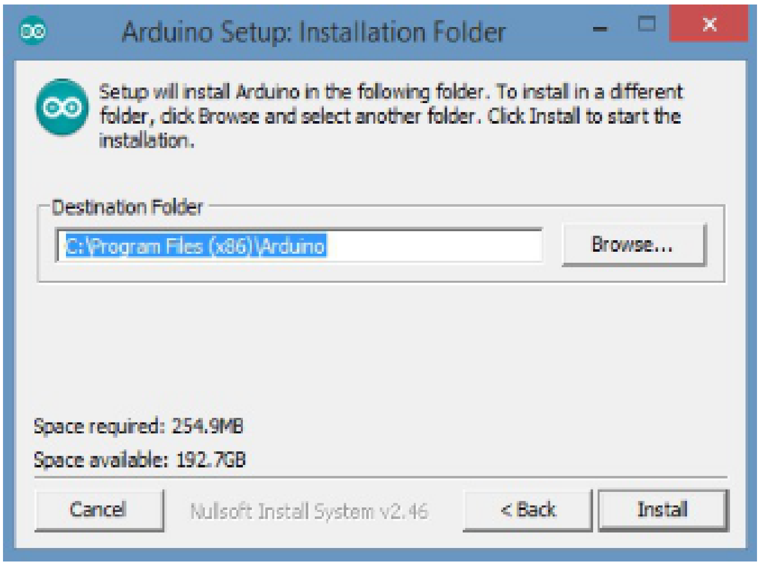
4. Click the button to agree to the licensing agreement:



5. Decide which components to install, then click "Next":

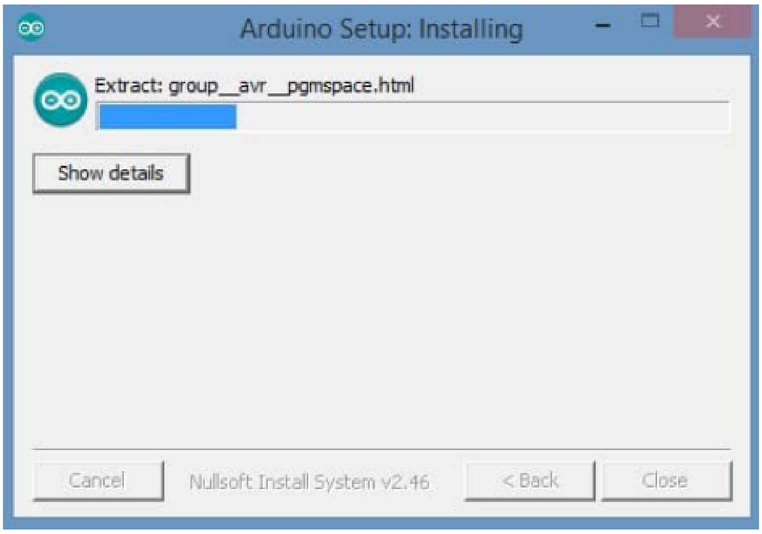


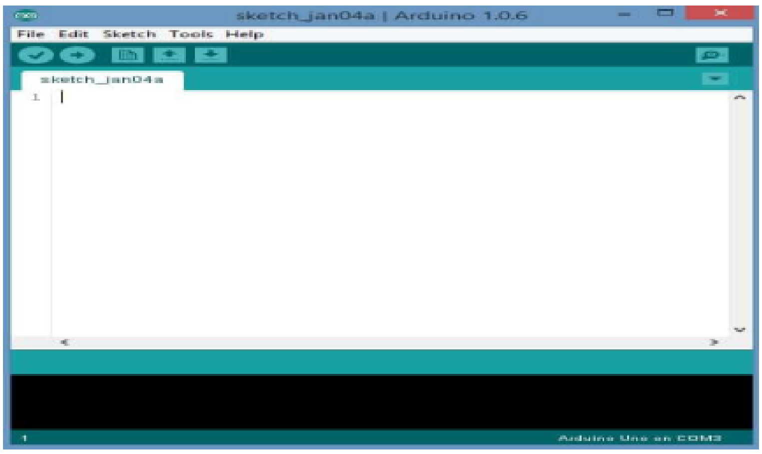
6. Select which folder to install the program to, then click "Install":



7. Wait for the program to finish installing, then click "Close":

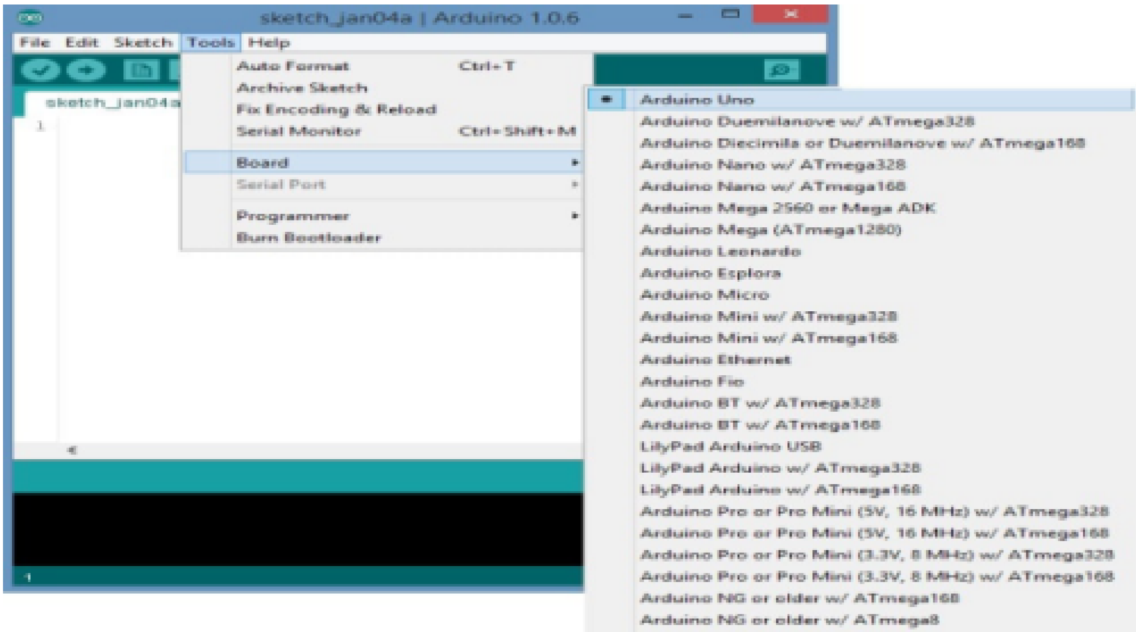
8. Now find the Arduino shortcut on your Desktop and click on it. The IDE will open up and you'll see the code editor:


Arduino Setup: Installing
Extract: group__avr__pgmspace.html
Show details
Cancel
Nullsoft Install System v2.46
< Back
Close


sketch_jan04a | Arduino 1.0.6
File Edit Sketch Tools Help
sketch_jan04a

4.1.4 Configuring the Arduino IDE

The next thing to do is to make sure the software is set up for your particular Arduino board. Go to the "Tools" drop-down menu, and find "Board". Another menu will appear, where you can select from a list of Arduino models. I have the Arduino Uno R3, so I chose "Arduino Uno".



4.1.5 Exploring the Arduino IDE

Take a minute to browse through the different menus in the IDE. There is a good variety of example programs that come with the IDE in the "Examples" menu. These will help you get started with your Arduino right away without having to do lots of research:

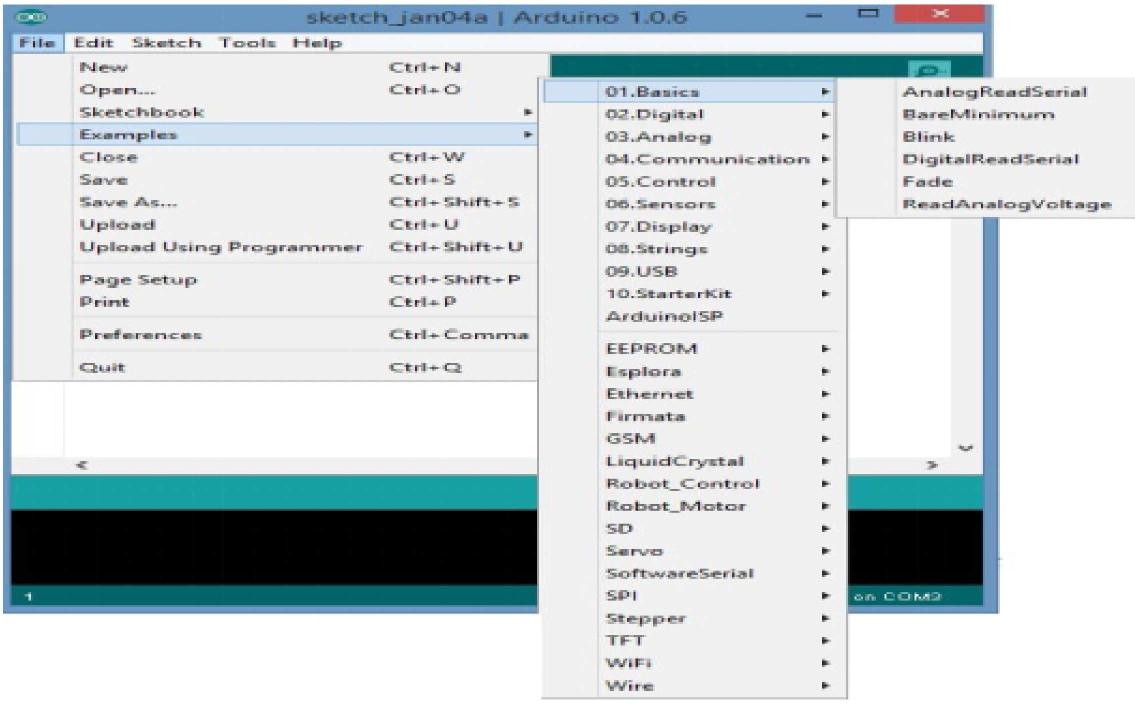


Figure 5: The Overview of Arduino IDE

4.1.6 Components Testing

Test ID	Inputs	Expected output	Actual Output	Remark
01	Dry Soil	Detects no moisture	Moisture not Detected	Pass
02	Wet Soil	Detects moisture	Moisture detected	Pass
03	Clay Soil	Detects Moisture	Moisture not Detected	Pass
04	OFF Motor	Turns on motor when moisture is below the set point.	Motor turned on	Pass
05	ON Motor	Turns off motor when moisture is above the set point.	Motor turned off.	Pass

Test ID	**Inputs**	**Expected output**	**Actual Output**	**Remark**
06	OFF Fan	Turns on when temperature goes above the set point	Fan turned on	Pass
07	ON Fan	Turns off when temperature goes below the set point	Fan turned off	Pass
08	OFF Filament bulb	Turns on when temperature goes below the set point.	Bulb turned on	Pass
09	ON Filament bulb	Turns off when temperature goes above the set point.	Bulb turned off	Pass

4.2 Implementation Details

This includes the details about technologies used for the implementation of this project and control flow of all the modules and sub modules.

4.2.1 Software Tools

Software tools helps in building the project as per the aim. Following are the software tools used for the project:

4.2.1.1 Arduino programming in Arduino IDE

Arduino programs are written in the Arduino Integrated Development Environment (IDE). Arduino IDE is a special software running on your system that allows you to write sketches (synonym for program in Arduino language) for different Arduino boards. The Arduino programming language is based on a very simple hardware programming language called processing, which is similar to the C language. After the sketch is written in the Arduino IDE, it should be uploaded on the Arduino board for execution. All the code for the Arduino sketch is written in the Arduino IDE and uses its own Arduino language . The sketch itself is composed of two parts: the setup() and the loop(). The setup() function is run once when the board is reset or powered up but the loop()

is repeated constantly and is where all the decision making happens. **Setup()** Code that only needed running once was written in setup ().The setup function is the first to execute when the program is executed, and this function is called only once. The setup function is used to initialize the pin modes and start serial communication. This function has to be included even if there are no statements to execute.

These are the areas covered in the project:

1. **Starting up the Bridge:** To enable communication between the two processors.

2. **Starting up the Console:** The Console allows the Arduino Yun to read data coming from the bridge and is a substitute for Serial. These are only viewable on the PC and are mainly for debugging purposes.

3. **Setting the pin mode:** All pins being used should be run with pinMode(pin, mode) to indicate whether it will be used as an input or an output.

4. **Starting the Yun Server :** This allows for server based calls to be made to the Yun e.g. sending sensor readings to the web application.

5. **Selecting the current plant settings form the database:**

This needs to be run once at the start so that the values can be used as the upper and lower bounds when monitoring the sensor readings. The next time this is run is when user changes which plant needs monitoring through the web application.

Loop() All other functionality that does not fall under setup occurs here. To keep the code tidy, different procedures were created for each piece of functionality. These procedures were then called within the loop and can be split up into six areas:

1. Take all the sensor readings and convert the values
2. Average out the readings using a moving window approach.
3. Compare the average readings against the plant settings.
4. Save the readings if the time limit has passed.
5. Print the readings and settings to the console.

4.3 System Execution Details

5 FUTURE SCOPE AND CONCLUSION

5.1 FUTURE SCOPE

Automated greenhouse monitoring system can be improved in many ways and can be used in wide applications. Following developments can be made in future.

- Another sensor such as Enzyme biosensors are used to detect excessive pestisides.
- Non-conventional energy source such as solar pannels, wind mills are used to supply power to the automated greenhouse monitoring system equipments. It has bright future scope of future in agriculture field and it will create a revolution on it.
- Multi source and single sink topology model to collect air pollution data.
- This system can be connected to communication devices such as modems, cellular phones or satellite terminal to enable the remote collection of recorded data or alarming of certain parameters.

- Time bound administration of fertilizers, Advanstar Communications Inc. insecticides and pesticides can be introduced
- A multi-controller system can be developed that will enable a master controller along with its slave controllers to automate multiple greenhouses simultaneously.

5.2 CONCLUSION

1. Using our system, one can save manpower, water to improve production and ultimately increase Profit.
2. The automated greenhouse system is feasible and cost effective for optimizing water resources for agricultural production.
3. The system would provide feedback control system which will monitor and control all the activities of irrigation system efficiently.

   The main advantage of this project is that, all the functions to be performed by the Fan and Sprinkler to control the climatic conditions like temperature, relative humidity and soil moisture levels in the Greenhouse environment are all automated and it does not require any human intervention. This is particularly an important factor because the presence and availability of the human cannot always be trusted on. For important structures like the greenhouses, we need a more dependable and reliable way for its management which is easily achieved by this project. Greenhouses are very important as they are responsible for the efficient growth of crops that are either necessary to feed the population or necessary for the economic growth of any country. Therefore, the management of these greenhouses is very important and the Green aims at providing just that.

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