Proceedings of the
34th International Conference on Information Technologies (InfoTech-2020)
IEEE Conference, Rec. # 49733, 17-18 September 2020, Bulgaria

REMOTE ACCESS OF A GREENHOUSE AUTOMATION

Pinar KIRCI, Hakan IGDELI

Bursa Uludag University,Computer Enginering Department
Istanbul University-Cerrahpaşa, Computer Enginering Department
pinarkirci@uludag.edu.tr
Turkey

Abstract: The formation of a suitable air conditioner environment for the growth and development of plants in greenhouses is provided by controlling the variables such as tempeature, relative humidity, and sunshine in the greenhouse. However, the climatic data desired in the greenhouse constantly change due to the effects of the sun, temperature, rain, etc. outside the greenhouse. Controlling variables from one hand is both difficult and costly. In this study, an automation is created to ensure that variables such as temperature, relative humidity, and solar radiation in the greenhouse are sensed with the help of sensors and remain within the desired intervals. This automation was implemented on a greenhouse model. The digital and analog data to be obtained from the sensors will be processed in the project and the data can be viewed on the computer screen. In addition, with the help of an android interface application created, remote access was provided to keep the system under control.
Key words: greenhouse, temperature, humidity, remote access

1. INTRODUCTION

Thanks to the rapid developments in the field of electronics and computers, the concept of automatic control has become widespread in every field and has made people's lives easier. Today, many domestic and foreign companies receive services from the automation industry. In this way, they both reduced labour costs and increased the rate of profit by speeding up production. In this study, using a microprocessor and computer, the control of a greenhouse is made remote and automated.

Automation system is the work provided by computers, mechanical tools and self-powered machines that was previously done with human labour. This definition was previously defined as the automatic transfer of materials from one machine to another during the manufacturing period, by performing a certain part of production in each, without the need for human labour. With the development of technology,

automatic communication and control mechanisms have been added to this system, communication is the operation of a machine or production vehicle in line with the information in the computer program [1].

Android was developed by the Open Handset Alliance and has reached a more widespread users with Google. It is a Linux based open source mobile operating system developed for mobile devices [2-3]. Android is an operating system suitable for application development.

Greenhouse is the facility where production and development conditions are artificially provided in regions or climates where the growing conditions of a plant cannot be met. It is a common method for a vegetable, fruit or flower not to be limited to only the seasons and regions where it can be grown [4].

It is estimated that the first greenhouse was used in a botanical garden in Italy towards the end of the 15th century. Then, especially in Europe, in the 17th century, protective and translucent greenhouses were started to be used by taking advantage of the feature of glass. These greenhouses are divided into three parts: cold, warm and hot. Among them, plants of the Mediterranean region, tropical and subtropical regions were also grown. The types of greenhouses that are divided into sections; on the soil, in the soil and on the wall are found in the Mediterranean region [5].

Greenhouse varieties common in the world: Cold greenhouse: Plants affected by light frosts and plants affected by heat are stored here. With the heating device, the temperature is kept only a few degrees above zero. Hot greenhouses: It is the places where equatorial and tropical plants are grown. In these, the temperature is normally kept at 30 ° C. It is dangerous for the temperature to drop below 15 ° C. For this, with a strong heat arrangement, plenty of water is needed to keep the humidity of the air high. Warm greenhouses: It is used for plants from Austria and South China. The temperature in the greenhouses should be between 10° – 15° C.

Greenhouses in the soil: Usually, such greenhouses are used in breeding farms. Production greenhouses: Very often it is used for growing seedlings and plants. In this type of greenhouses, the heating device is made from below. It usually consists of structures covered with a glass frame and is very costly. To grow seedlings in turmain, simple greenhouses with oblique glass are also used.

Wall-based greenhouses: The north side is leaned against the wall, allowing the sun to enter completely from the south. It needs little heat. It has a low cost. Quick ripening greenhouses: This type of greenhouse varies depending on the plant and fruit to be ripened. No matter what type of greenhouse, it must have the feature that it can receive plenty of sun [5-7].

2. PROJECT DESIGN

By bringing greenhouse climates to desired values, it is ensured to increase the quality of the product grown in the greenhouse, increase the growth rate and give more products. The most important greenhouse climate features; such as indoor air temperature, soil moisture, air humidity and amount of light. Increasing or decreasing

these values significantly affect the quality of the products. In this study, it will be tried to be shown by the experiment that the yield and quality of the product can be increased when the climate conditions in the greenhouse are kept at the desired values.

As Arduino is open source, it is designed by producing different plugins for many different purposes. These additions and Arduino structure save time by not doing work like soldering, microcontroller circuit setup. In this way, projects can be prototyped and implemented more quickly [8].

DHT11 Temperature and Humidity Sensor Module, DHT11 is a sensor board based on temperature and humidity sensor. Card can measure temperature between 0^0C-50^0C and humidity between 20% -90% RH [9]. In the greenhouse model I created, I used the dht11 humidity and temperature sensor to obtain indoor greenhouse temperature and humidity information.

The soil moisture sensor is a sensor that you can use to measure the moisture content of the soil or the level of a small scale liquid. Moisture meter probes are used by immersing them in the environment to be measured. Due to the resistance caused by the soil or the liquid immersed in it, a voltage difference occurs between the probe stylus. Humidity can be measured according to the magnitude of this voltage difference. As the humidity in the soil increases, its conductivity increases. Sensitivity can be adjusted with the trimpot on the card [10]. In the greenhouse model I created, I used the soil moisture sensor to measure the humidity of the greenhouse soil. According to the information I obtained here, I determined the working range of the water engine.

LDR Light Sensor is produced from photosensitive materials such as Silicon (Si), Germanium (Ge) and Cadmium Sulfur (CdS), as well as Diodes and LEDs (Light Emitting Diode), which are also types of diodes. When the amount of light falling on it increases, the resistance value increases, and as the amount of light falling on it decreases, the resistance value decreases.

LDRs can be used in many areas from automatic control of street lights to determining toner density in copiers. In this project, it was used to check whether the greenhouse can get light. In other words, it was used to answer the question of whether there is sunlight or not within the 24-hour period. [11].

Water pump, The pump switches on and off according to the data from the soil moisture sensor. The pump can operate at 4.5-12 volts voltage. In the greenhouse model I created, the water engine was used to adjust the moisture content of the soil.

In the greenhouse model, the servo motor is used to open and close the roof. It can be operated manually as well as in the event that the amount of moisture in the greenhouse increases excessively, it works together with the fan to ensure that the moisture content in the greenhouse remains at the desired level.

3. ANALYSIS AND RESULTS

The greenhouse automation system can be controlled from the computer and android interface. Arduino and android application communicate with Bluetooth.

Greenhouse Automation Interface, The android application of the system works in two modes, these are automatic and manual mode. In manual mode, the person turns the actuators on and off herself. In automatic mode, it operates according to the intervals defined in the system. This application was made through the MIT APP inventor site.

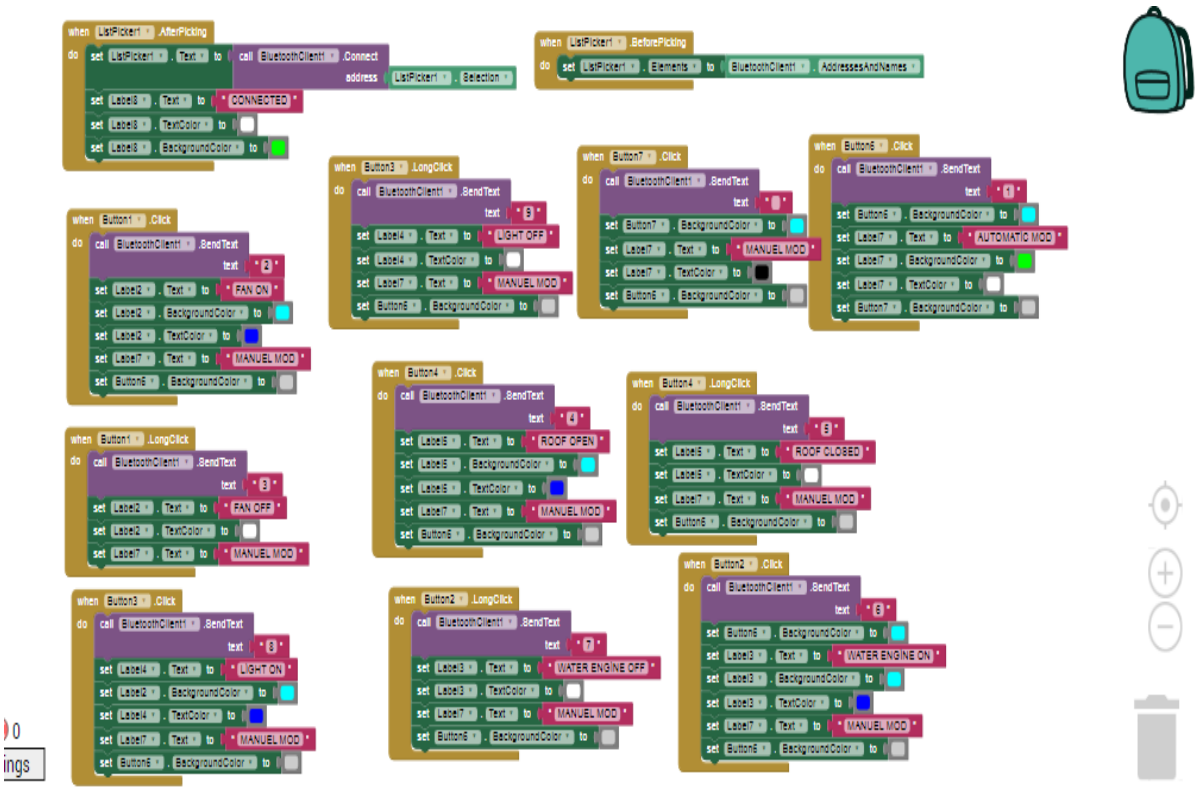

Fig. 1. The design and block diagram scheme of the system

The blockdiagram of the greenhouse interface created is shown in Figure1.

- Create a Bluetooth client
- ListPicker creation
- Create a button
- Create a label

Bluetooth client created for the interface to communicate with arduino. Bluetooth devices suitable for connecting around were displayed with Listpicker. With the block created, the user was informed with the status information on the interface when connected to the bluetooth device.

In the button blocks, it is provided to operate the desired devices by sending the previously determined numbers (1 to 9) to the arduino with the bluetooth client. For example, when 2 was sent to Arduino, Arduino sent electricity to the fan and enabled it to work.

With the label on the blocks, information such as fan on/off, water engine on /off, roof on/off were presented to the user.

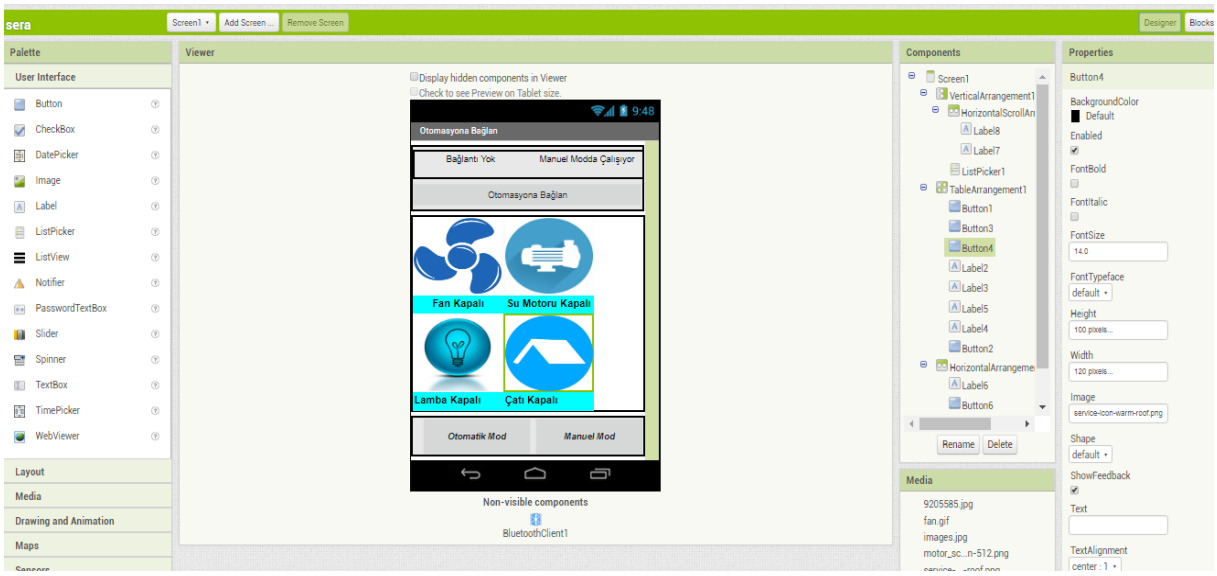

Fig. 2. The Automation interface

Various information in the greenhouse automation interface is presented to the user in Figure 2. Some of those are

- Connection status of the greenhouse
- In which mode the automation works
- For manual use
- fan on-off
- water engine on-off
- light on and off
- roof opening and closing buttons

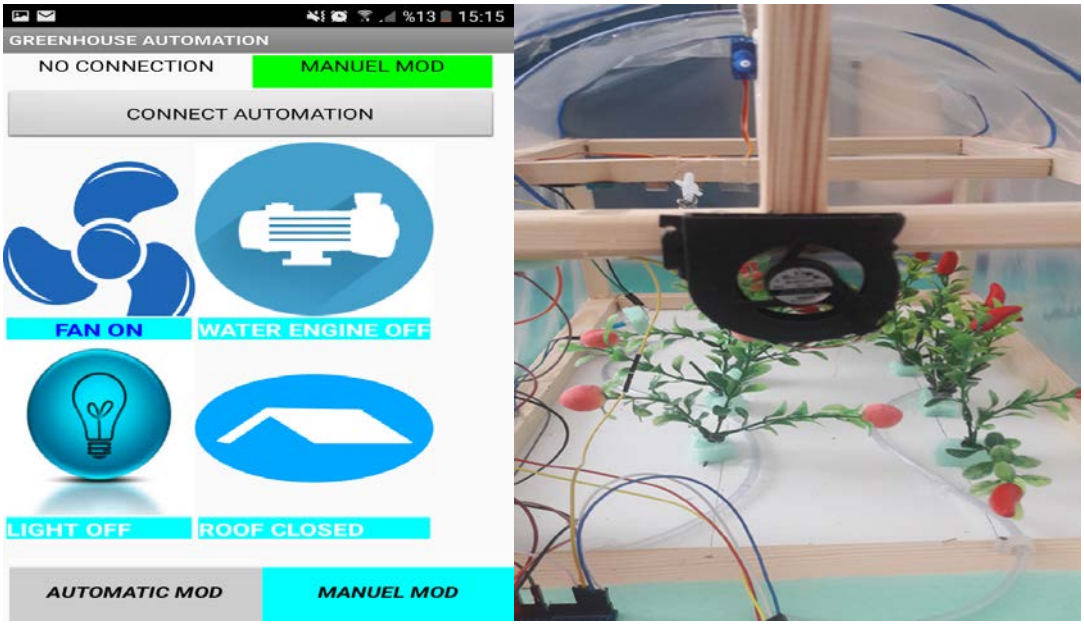

Fig. 3. The fan is on

It becomes open in one short press to the buttons. When the button is on, information text appears on the labels. When the button is pressed for a long time, it turns off. Images of the situations are presented in Figure 3, Figure 4, Figure 5 and Figure 6.

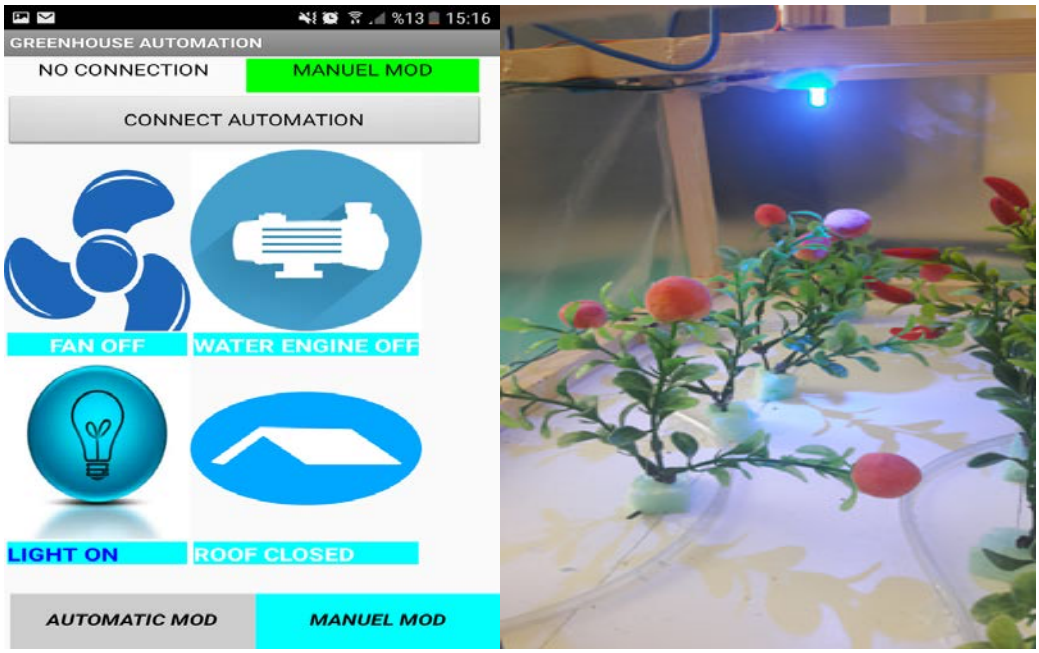

Fig. 4. The light is on

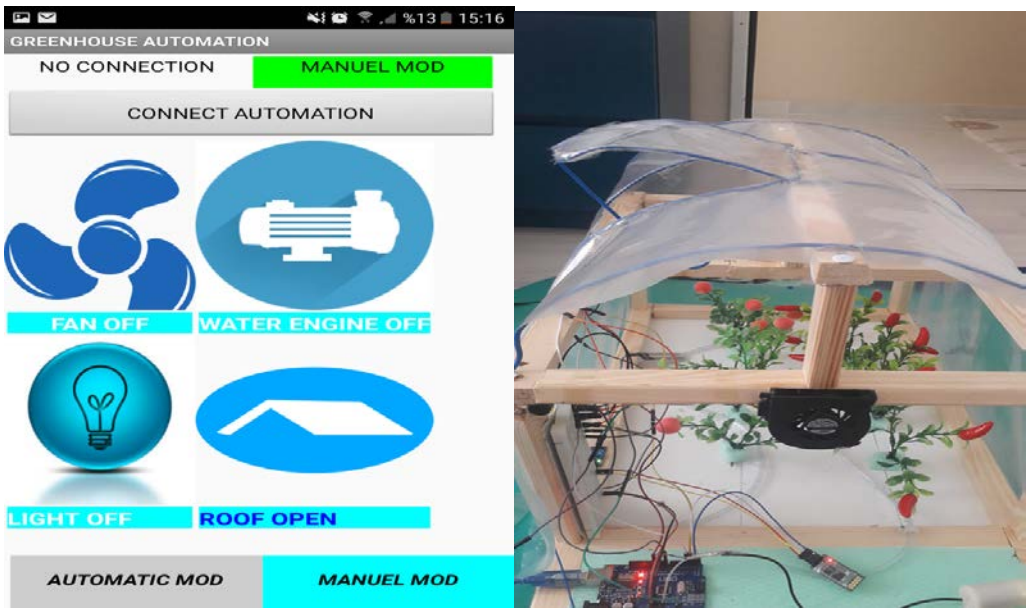

Fig. 5. The roof is open

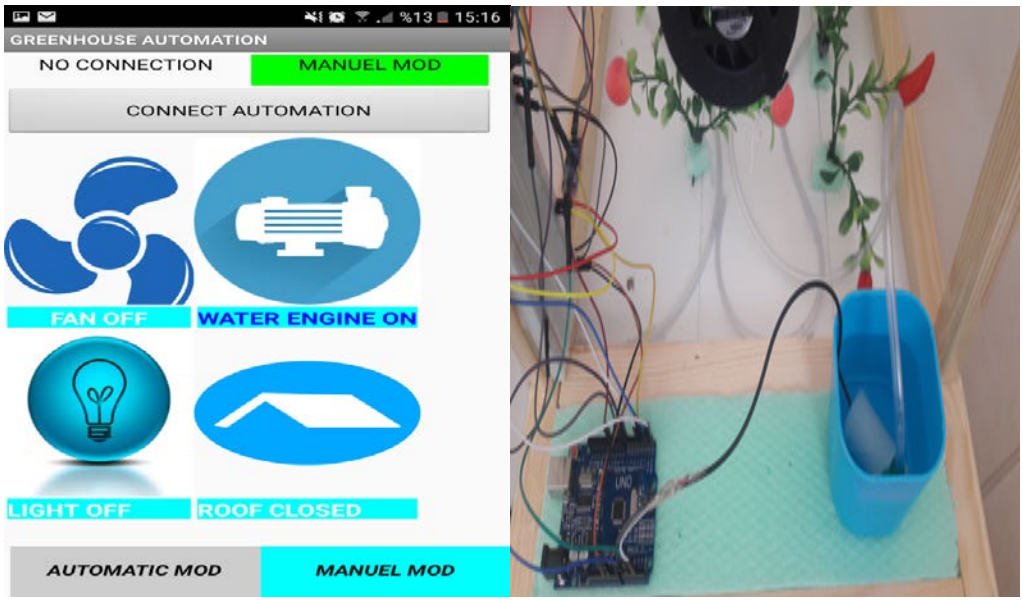

Fig. 6. The water engine is on

4. CONCLUSION

In Turkey, in the majority of greenhouses, temperature, humidity and fresh air amount are still controlled manually with old systems. In greenhouses built in many countries, modern systems and automation are more widely used.

It has been experimentally observed that the products grown in the greenhouse, which are produced in automatic control, are having better quality and the growing time is approximately 15 days shorter compared to the products grown in other classical greenhouses.

In this study, a simple, inexpensive and easy-to-use mechanism designed to ensure that the humidity, light and temperature values within the greenhouse remain within the desired range despite the external effects of the environment in a prototype greenhouse. The device used in the study can easily be utilized in greenhouses that are already installed and will be installed.

REFERENCES

[1] Hdcotomasyon, Access date: 22.10.2019 – http://www.hdcotomasyon.com.tr/otomasyon-sistemleri-nelerdir

[2] Wikipedia, (http://tr.wikipedia.org/ wiki/Android), Access date: 24.12.2019

[3] Gelecegiyazanlar, Access date: 28.11.2019 https://gelecegiyazanlar.turkcell.com.tr/konu/android/egitim/android-201/android-mimarisi-ve-sistem-ozellikleri)

[4] Y. S. Arı,Birden Fazla Seranın, PLC ve SCADA Yazılımı İle Kontrolü ve İnternet Üzerinden İzlenmesi, Master Thesis, Marmara University, Institute of Science, İstanbul, 2011.

[5] Turkcebilgi, Access date: 24.12.2019, https://www.turkcebilgi.com/sera)

[6] M. Ciğer,Bilgisayar Kontrollü, İnternet Destekli Sera Otomasyonu, Master Thesis,, Çukurova University, Institute of Science, Adana, 2010.

[7] Shu, X., et al. (2009). Research on mobile location service design based on Android. Wireless Communications,. 5th IEEE International Conference on Networking and Mobile Computing, 2009 WiCom'09

[8]. Robotiksistem, Access date: 10.08.2019
http://www.robotiksistem.com/arduino_uno_ozellikleri.html

[9] DHT11 Data Sheet, D-Robotics, Access date: 11.09.2019
https://datasheetspdf.com/pdf/785590/D-Robotics/DHT11/1

[10] Robotistan, Access date: 10.04.2019
https://www.robotistan.com/toprak-nemi-algilama-sensoru)

[11] LDR Data Sheet, RS Components, Access date: 10.12.2019
https://components101.com/sites/default/files/component_datasheet/LDR%20Datasheet.pdf