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Programing and Implementation of Wireless Monitoring Automatic Control System for Irrigation Greenhouse using ATMEGA328P-PU-AVR Microcontroller

برمجة وتنفيذ منظومه لاسلكية ذاتية التحكم للمراقبة والسيطرة على ارواء مشتل منزلي باستخدام مايكروكونترولر نوع ATMEGA328P-PU-AVR

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ABSTRACT:

At present there are the speed and diversity in scientific innovations so that they intervene in the way of life of individuals and make life easier. There are a lot of researchers who invented irrigation systems, which rely on the control system that facilitates the path towards robust system for irrigation. In this paper a new system for monitoring and operation of irrigation system for smart gardenwas designed, which depends on the microcontroller ATMEGA328P-PU, which are programmed using the Arduino Uno board. The new idea is that the board Arduino Uno works as a programmer for the purpose of controlling the programming software and then the microcontrolleroperates independently without need Arduino Unoboard. System works with two factorswhich are the plant soil moisture and temperature with humidity surrounding the plant through two types of sensors so that the process of perfusion in the case of a lack of water into the soil or run the cooling fan in the case of high temperature and humidity around the plant. The control temperature and humidity are read by mobile device using the Bluetooth device connected with the controlleralso the results are displayed by the liquid crystal associated with the system. The results showed that the system is strong and sensitive against changing humidity and temperature and has the ability to restore the balance of these changes accurately and efficiently under all weather conditions, so this kind of control devices can be used for the cultivation of some rare plants that need specified temperature and humidity, which utilized in medical fields for the production of medicines.

Keyword:irrigating system,smart garden, ATmega328 microcontroller, Arduino Uno board, Moisture Sensor, Bluetooth device

الخلاصة

في الوقت الحاضر هناك سرعة وتنوع في الابتكارات العلمية بحيث انها تدخل في طريقة حياة الافراد وتجعل الحياة اسهل. هناك الكثير من الباحثين الذين اخترعوا انظمة للري والتي تعتمد على نظام التحكم التي تسهل الطريق نحو نظام متين للري. في هذه البحث تم تصميم نظام جديد لمراقبة وتشغيل منظومة للري الذي يعتمد على متحكم ATMEGA328P-PU والتي يتم برمجتها باستخدام لوحة اردوينو اونو. الفكرة الجديدة هي ان لوحة اردوينو تعمل كجهاز مبرمج لغرض برمجة المتحكمة ونقل البرنامج اليها ثم تعمل المتحكمة بصورة مستقلة دون الحاجة الى لوحة الردوينو اونو. يعمل النظام مع عاملين وهما رطوبة التربة للنبات ودرجة الحرارة مع الرطوبة التي تحيط بالنبات عن طريق نوعين من اجهزة من اجهزة الاستشعار بحيث يقوم بعملية الارواء في حالة نقص في المياه داخل التربة او تشغيل مروحة تبريد في حالة ارتفاع درجة الحرارة والرطوبة المحيطة بالنبات. يتم مراقبة درجة الحرارة والرطوبة من قبل اجهزة الموبايل باستخدام جهاز بلوتوث متصل بالمتحكم كما ويتم عرض النتائج عن طريق شاشة الكريستال السائل المرتبطة مع النظام. اظهرت النتائج أن النظام قوي وحساس ضد تغير الرطوبة ودرجة الحرارة ولديه القدرة على اعادة توازن هذه التغيرات بدقة وبكفائة عالية جدا ضمن كافة الظروف المناخية.

الكلمات المفتاحية : نظام السقي،الحديقة الذكية،اتميغا328 مايكروكونترولر،بورد اردوينواونو،حساس الرطوبة، جهاز بلوتوث

1. INTRODUCTION

On the planet, water advancement for horticulture is a need, yet ineffectively composed and arranged watering system water administration methodology and practices undermines endeavors to enhance vocations and uncovered individuals and environment to dangers. By a long shot, one of the biggest misfortunes of the plant materials in the homestead is the immediate aftereffect of the inappropriate watering system planning**[M.D. Dukes*et.al*., (2007)]**. Watering system water administration requires opportune use of the appropriate measure of liquid. Rivalry for liquid, constrained liquid assets and attentiveness toward surroundings are creation great watering system administration more critical **[S. Siebert*et.al*., (2007)]**.

There are numerous sorts of measuring devicewithin business sector that able utilized to gauge the dirt dampness. Certain of thatmeasuring devices depend on resistor standard and specific in capacitor guideline. Out of various microcontrollers accessible in the business sector, the one, which is single board microcontroller, relative of the open-source wiring stage intended to make the way toward utilizing hardware as a part of multidisciplinary tasks was ATmega328. It is an open source microcontroller stage of gadgets prototyping taking into account adaptable and great interface amongst equipment and programming**[KshitijShinghal*et.al*., (2010)] [Kirsten L. andElfatih A. B., (2003)]**. This paper manages ATmega328 microcontroller to changerun or turn off the water pump consequently once the dirt dampness measuring device recognizes the water to the plants and the measure the warmth around the plants and after that open the entryway with fan is turned on then send this temperature degree to the Bluetooth gadget to peruse by the Gardner**[Swati Devabhaktuni and D.V.Pushpalatha, (2013)]**.

This paper is arranged as in the beginning the small introduction about the irrigation system and the relative process of irrigation then brief description of ATMega328P-PU is mentioned also describe the programming device which is the Arduino platform. After that explain the process of programming the microcontroller using the Arduino board and how can do this technique with all details. Then describe the connection of the system and how the sensors are connected to the microcontroller. After that the brief description of all the components that is used in this paper are mention. The results when running the system for working from the side of humidity and heat degree also discussed. Finally the conclusion is written to see the powerful and robust of the system

2. ATMega328P-PU-AVR Microcontroller

The Atmel 8-bit AVR RISC-based microcontroller as shown in figure1consolidates 32 KB ISP memory with read-while-compose abilities, numerous guidelines performed in a solitary fixed cycle **[SrinubabuAravapalli*et.al*.,(2012)]**. The most prevailing specifications incorporates: **"**High Performance, Low Power Design, 8-Bit Microcontroller Atmel AVR advanced RISC architecture, 131 Instructions most of which are executed in a single clock cycle, Up to 20 MIPS throughput at 20 MHz, 32 x 8 working registers, 2 cycle multiplier, Memory Includes32KB of programmable FLASH, 1KB of EEPROM, 2KB SRAM, 10,000 Write and Erase Cycles for Flash and 100,000 for EEPROM, Data retention for 20 years at 85°C and 100 years at 25°C, Optional boot loader with lock bits, In System Programming (ISP) by via boot loader, True Read-While-Write operation, Programming lock available for software security, 2 x 8-bit Timers/Counters each with independent pre-scalar and compare modes, A single 16-bit Timer/Counter with an independent pre-scalar, compare and capture modes, Real time counter with independent oscillator, 10 bit, 6 channel analog to digital Converter, 6 pulse width modulation channels, Internal temperature sensor, Serial USART (Programmable), Master/Slave SPI Serial Interface - (Philips I2C compatible), Programmable timer with independent internal oscillator, Internal analog comparator, Interrupt and wake up on pin change, Internal calibrated oscillator, Power on reset and programmable brown out detection, External and internal interrupts, 6 sleep modes including idle, ADC noise reduction, power save, power down, standby, and extended standby, 23 programmable I/O lines, 28 pin PDIP package, Operating voltage:1.8 - 5.5V, Operating temperature range:40°C to 85°C, Speed Grades:0-20 MHz at 4.5-5.5V and finally Low power consumption mode at 1.8V, 1 MHz and 25°C:Active Mode: 0.3

mA."**[A. ALGEEB *et.al*. (2010)][K. Sreenivasa Ravi*et.al*. (2013)]**. Thepin configuration of the ATMega328 is shown in figure 2.

3. The Programming of the system using the Arduino board

In this part the procedure of programing the microcontroller ATMega328 is describe in details. This procedure need extra components in order to complete the process of programming the microcontroller which are: An Arduino Uno board as shown in figure 3, 18pf capacitors (x2), 16 MHZ oscillator, Bread board, 10K ohm resistor, Jumper wires as shown in figure 4.

Now Assemble everything (on a bread board): "connect Arduino board (pin10) to microcontroller (pin1), connect Arduino board (pin11) to microcontroller (pin17), connect Arduino board (pin12) to microcontroller (pin18), connect Arduino board (pin13) to microcontroller (pin19), connect (pin 7) and (pin20) of microcontroller to +5v of Arduino board, connect (pin8) and (pin 22) of microcontroller to GND of Arduino board, connect 10K ohm resistor from (pin 1) of microcontroller to +5V on Arduino, connect 16 MHZ oscillator from (pin 9) to (pin 10) on microcontroller, connect 18pf capacitors: first one from (pin 9) to GND , second one from pin 10 to GND.". The finally connection is shown in figure 5.

Now, attach the Arduino device with the source of program (like laptop) and run program of downloading commands using the USB cable connection. At once the program is running then the commands will copies to Arduino and the ATMega328 microcontroller at the same time. When the process of transferring the commands to microcontroller is finished then the microcontroller can split from the connection and now it can works standalone without need of Arduino board.

Figure 1: the I.C of ATMega328 microcontroller

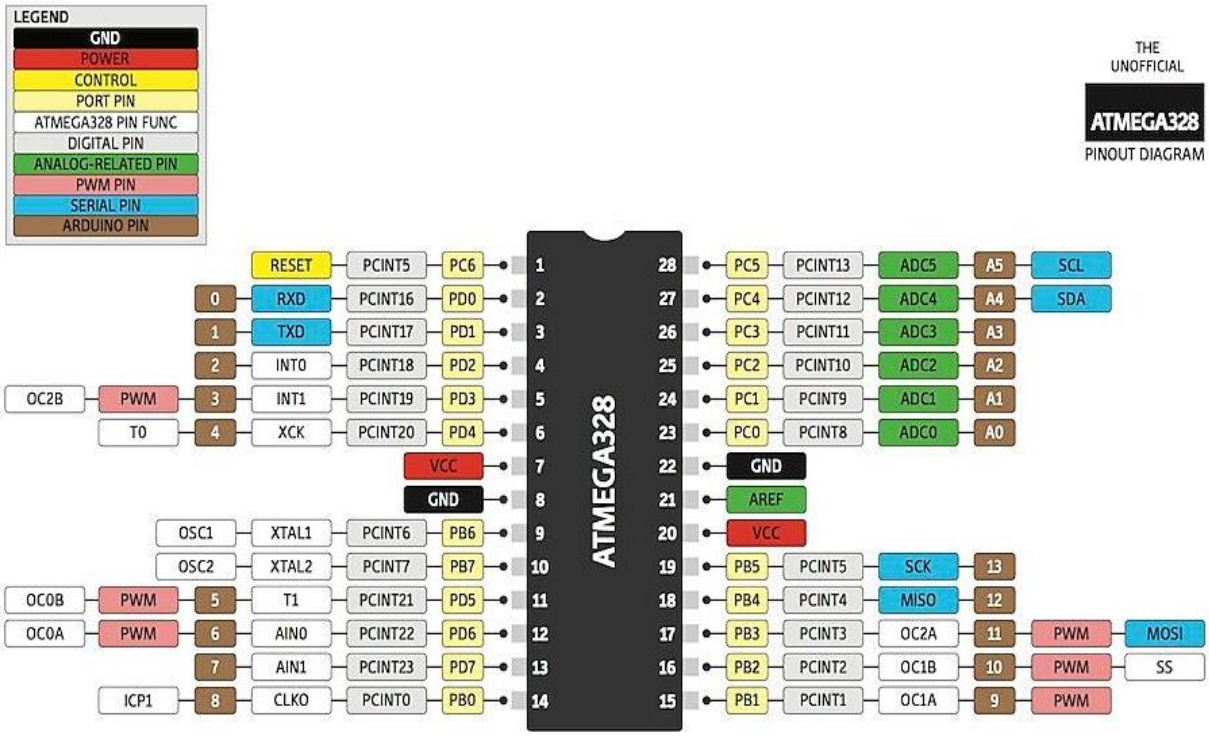

Figure 2: the pin out diagram and function of ATMega328 microcontroller

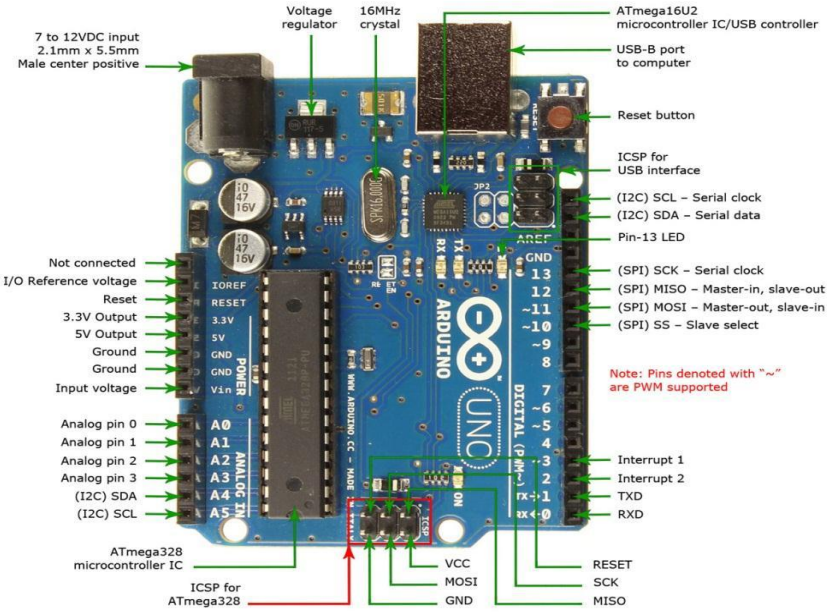

Figure 3: the shape of Arduino board with pins function

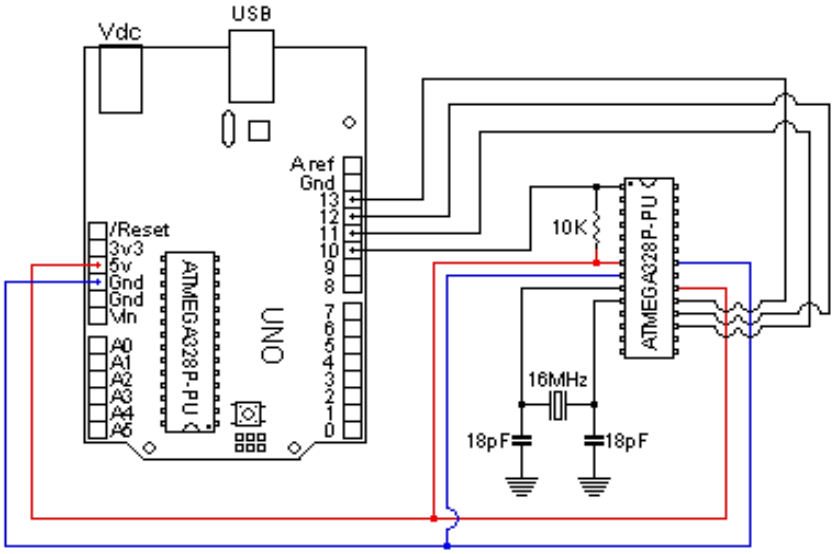

Figure 4: the connection for programming the ATMega328 using Arduino UNO

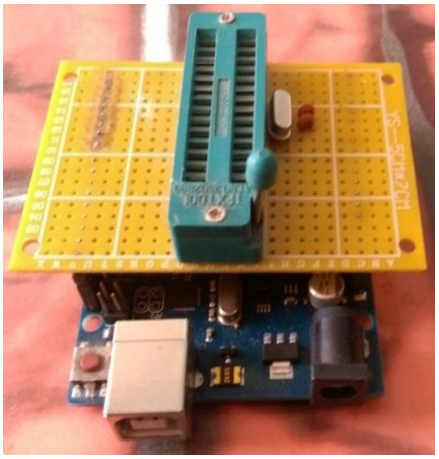

Figure 5: the final connection for programming

4. The components of the system

In this section the brief description of the components will be mention here. These components are connected to the microcontroller in order to complete the function that is used for it. These components are: Regulated power supply, ZIF for programming, Crystal oscillator, Soil moisture sensor, Heat sensor, Speed fan, Water pump, Servo motor, Bluetooth device HC-05 , Humidity and Temperature Sensor DHT11.

4.1 The Moisture Sensor:

mudMoisture sensors check the liquidlevel in mud. A mudsensormeasure is included of variousmudwetness measuring device. mudconductivity is just measure utilizing dualmetallic channels divided separated mud aside from that disintegrated cure incredibly modify the liquid conductancealso able to frustrate the estimations. Two wires set in the dirt pot shape a variable resistor, whose resistance shifts relying upon soil dampness. This variable resistor is associated in a voltage divider setup, and Arduino gathers a voltage relative to resistance between the two wires**[M. D. Dukes and J. M. Scholberg, (2005)]**.This sensor is shown in figure 6.

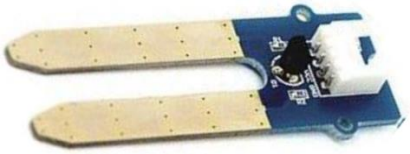

Figure 6: the moisture sensor

4.2 ZIF

(Zero Insertion Force Socket) permits you to embed and expel chips effortlessly from a current circuit as appeared in figure 7. These are frequently utilized for chip software engineers or when you have to test a chip without harming it. Move the lever up and chips drop right in. Move the lever down to "hook" the chip set up. This attachment is intended for DIP chips of up to 28 pins and 0.3inch wide**[Joseph M. Craine and Theodore M., (2011)]**.

Figure 7: the ZIF (for programming)

4.3 Water Pump:

The water pump as appeared in figure8 is utilized to provideliquid for a definite errand. It couldstartedrun or stop by transfersigns as required. The procedure of providingliquid is defined as driving. **[MahirDursun andSemihOzden, (2011)]**.

Figure 8: the water pump

4.4 Servo Motor

It isnever an alternate type of machine, on the premise of basic working rule, however utilize servo instrument to accomplish shut circle control with a nonexclusive open circle engine. At the end of the day, a servomotor is only a customary engine with a sensor introduced, normally to gauge rakish position amid operation. A servomotor as appeared in figure9 is a particular sort of engine and rotational encoder mix that structures a servomechanism. This get together may thusly frame portion of a different servo-mechanism. The coder provideslocation and for the most part speed input**[D. Fangmeier*et.al.* (2009)].**

Figure 9: the servo motor

4.5 Bluetooth device HC-05

The Bluetooth deviceHC-05 module can be regarded as " a simple to utilize Bluetooth SPP (Serial Port Protocol) module, intended for straightforward remote serial association setup. Serial port Bluetooth module as appeared in figure10 is completely qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio handset and baseband. It utilizes CSR Blue center 04-External single chip Bluetooth framework with CMOS innovation and with AFH (Adaptive Frequency Hopping Feature). It has the impression as little as 12.7mmx27mm. Trust it will improve your general configuration/advancement cycle". The association is so straightforward and little; there is just little association with be made. You can interface the RX, TX, 5V and GND to TX, RX, VCC and GND individually. The brief portrayal of this gadget is: "Typical -80dBm sensitivity, Up to +4dBm RF transmit power, Low Power 1.8V Operation ,1.8 to 3.6V I/O, PIO control, UART interface with programmable baud rate, With integrated antenna, With edge connector."**[Shinghal K. *et.al.*, (2010)]**.

Figure 10: the Bluetooth device

4.6 Humidity and Temperature Sensor DHT11

The DHT11 is a moderately modest sensor for measuring temperature and Humidity. As appeared in figure11 it has four lines: GND, +5V single information line and one is not association NC. By method for a handshake, the qualities are checked out over the single computerized line. The particular of this sensor can be outlined as: "Humidity Range: 20-90% RH, Humidity Accuracy: ±5% RH, Temperature Range: 0-50 °C, Temperature Accuracy: ±2% °C, Operating Voltage: 3V to 5.5V"**[Benzekri A. *et.al.*, (2007)]**.

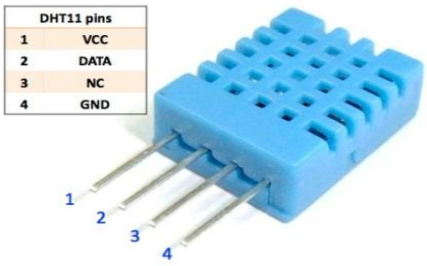

Figure 11: the humidity and temperature sensor

5. The description and connection of proposed system

"There are three functional components in this project which are: the moisture sensors with the water pump, the heat sensor with the fan speedconnected toservo motor for open the gate and the third part is the Bluetooth device for send the information to the monitoring system (mobile or laptop)to monitors the change of heating and humidity inside the greenhouse".

This project uses ATMega328 to controls the water pump, speed fan and servomotor (open gate). Figure12 shows the schematic to connect the ATMega328 to these components. The machineareprovided by a 12 volt via the driver in order to guard the microcontroller from burn. The dampness sensor tests the quantity of dampness in the mud and transmit the data to the ATMega328 ifneed the water.

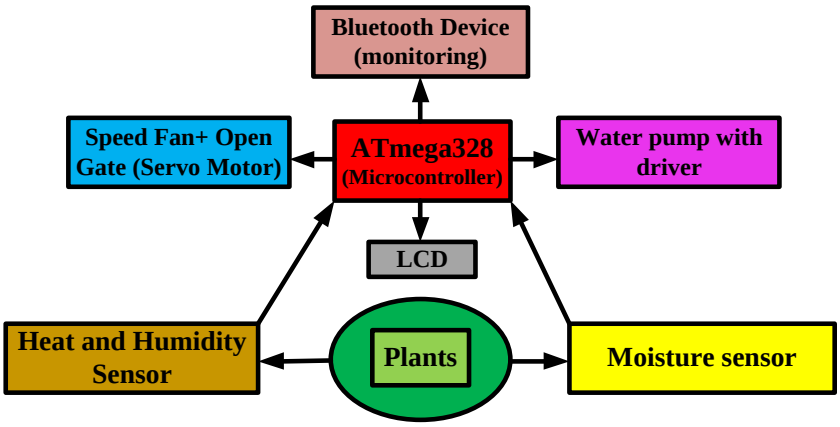

Figure 12: the block diagram of the system

In this system the Bluetooth device (HC-05) is connected to microcontroller through the pins Rx and Tx (2 and 3)and then transmit the information to another device such as mobile or laptop. The LCD also connected to the system through the digital pins (4, 5, 6, 11, 17, 18) while the microcontroller takes the power through the pins 7 and 8. The microcontroller needs the crystal oscillator with two capacitors 18 Pf with special configuration as shown in figure13 and this crystal oscillator is connected to pins 9 and 10. The sensor that reading the temperature will connected to pin13 while the fan that will equalize the exceed heating is connected to pin 12 with LED1 to indicate that fan is ON. The servo motor that will open the gate of fan will be connected to pin 15. The heating sensor, fan and the servo motor are working together in order to reduce the overheating inside the greenhouse. The second sensor which is moisture sensor is connected to microcontroller through the pin 23. when the soil need water then this sensor give trigger to microcontroller in order to run the water pump that is connected to system through pin19 with LED3 to indicate the running water pump while when the water pump in off state the special LED2 is ON connected to pin 16 to indicate that the water pump is in Off state.

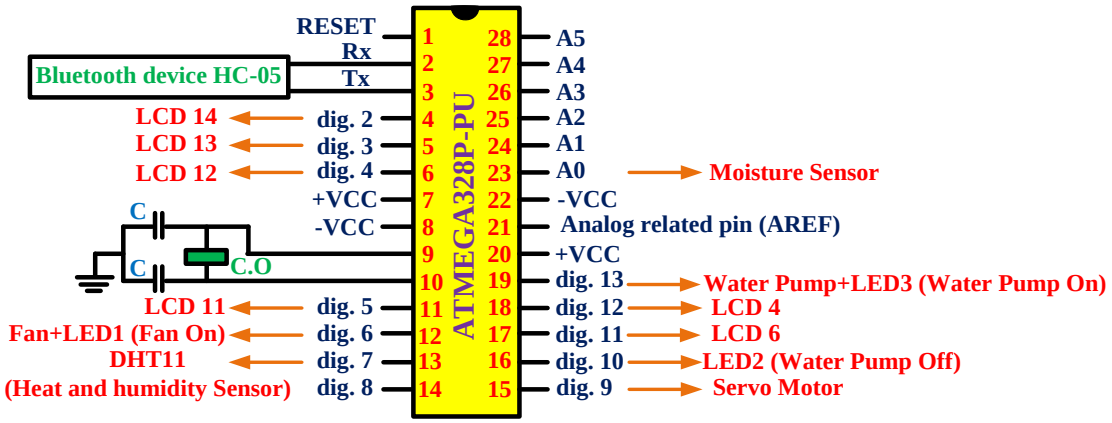

Figure 13: the pin connection of the proposed system

6. RESULTS AND DISCUSSIONS

It can be seen from figure14 that the core of the system is the microcontroller ATMega328 and all the components are connect to it. The moisture sensor is put inside the soil to measure the humidity of soil. In the first place you have to empower your water pump from microcontroller. Some of them may have distinctive current prerequisites, mine takes a shot at current: 0.05A~0.12A. In any case, microcontroller I/O pins have some ebb and flow impediments (up to 40.0 mA), hence we will utilize a driver as an exchanging gadget, associated specifically to VCC.

When the soil loss the water or the level of moisture under the desired level then this sensor send the trigger to microcontroller then the microcontroller send the information signal (logic 1) to the driver of water pump to run the pump and feed water to soil. When the moisture level reach desired level then the sensor send the trigger to microcontroller to stop the motor and the microcontroller send the information (logic 0) to the driver to turn off the motor. Also the microcontroller senses the temperature degree and humidity level via the temperature and humidity sensor.When the temperaturelevel passes the threshold then the microcontroller sends the trigger to the servo motor to open the gate and run the speed fan to equalize or reduce the heating and humidity inside the greenhouse by changing the air inside it until reach the desired degree of temperature then stop the fun and close the gate using the servo motor."

The aggregate project is keep running at once and the outcomes are watched. This paper is helpful for the rural purposes where dampness is consistently required. Furthermore, now and then at rustic territories the electric wires may fall on the ground. Since the dampness substance is high on the ground the individual who touches the ground may encounter a stun. So all together keep from the stuns this paper might be valuable and is likewise helpful in perceiving the substance of the dampness in the ground.

Measuring soil dampness is imperative in agribusiness to help ranchers deal with their watering system frameworks all the more effectively. Not just are ranchers ready to by and large utilize less water to grow a harvest, they can expand yields and the nature of the product by better administration of soil dampness amid basic plant development stages.

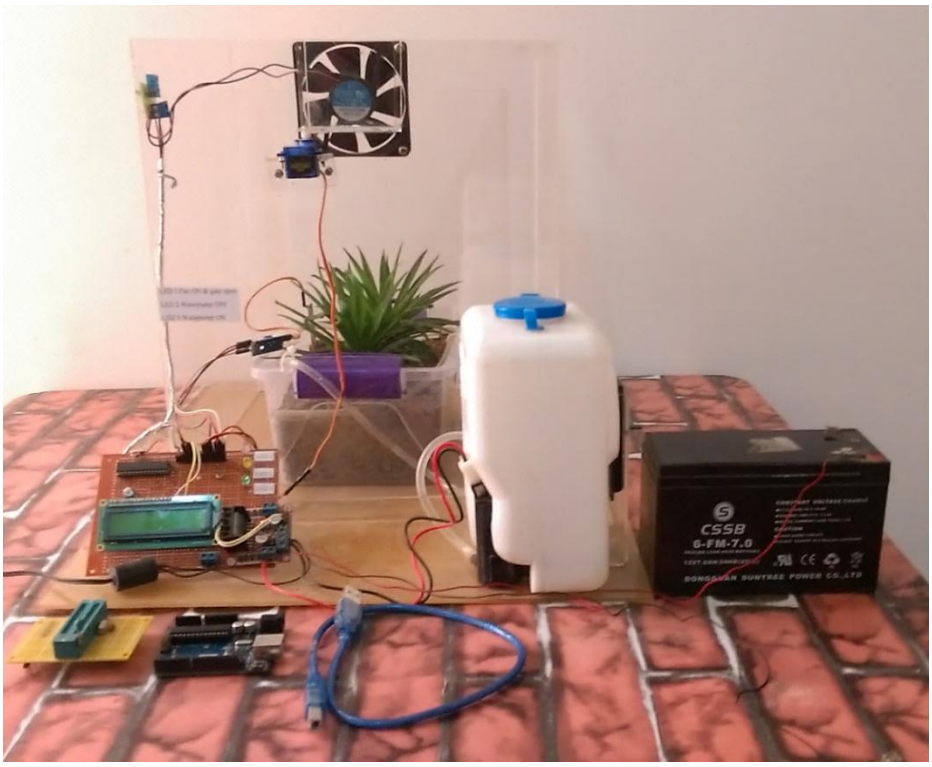

Figure 14: the proposed system with all connections and sensors

7. CONCLUSIONS

In this paper anew strategy was designed to aggregate productive framework for watering the mud and even out the temperature inside the nursery in view of microcontroller which is administer on water pump, fan speed and open the entryway of nursery to diminish the temperature degree to be appropriate for plants. The new thought in this paper utilizing the Arduino stage as software engineer gadget not as controller and this new method will lessen the expense of controller framework and make it more less expensive. In this framework we can administer on mugginess temperature and dampness of the mud in the same time and with exceptionally touchy degree to run fan or water pump. Subsequently, this framework which depends on microcontroller is exceptionally appropriate to put inside the nursery particularly for some touchy plants which need precise level of temperature and extraordinary level of dampness. Specifically, there is some therapeutic plants which is utilized for medications require this unique climate to keep focused. Hence, this framework is extremely productive for developing the uncommon plants and expands it in financial and shoddy system.

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