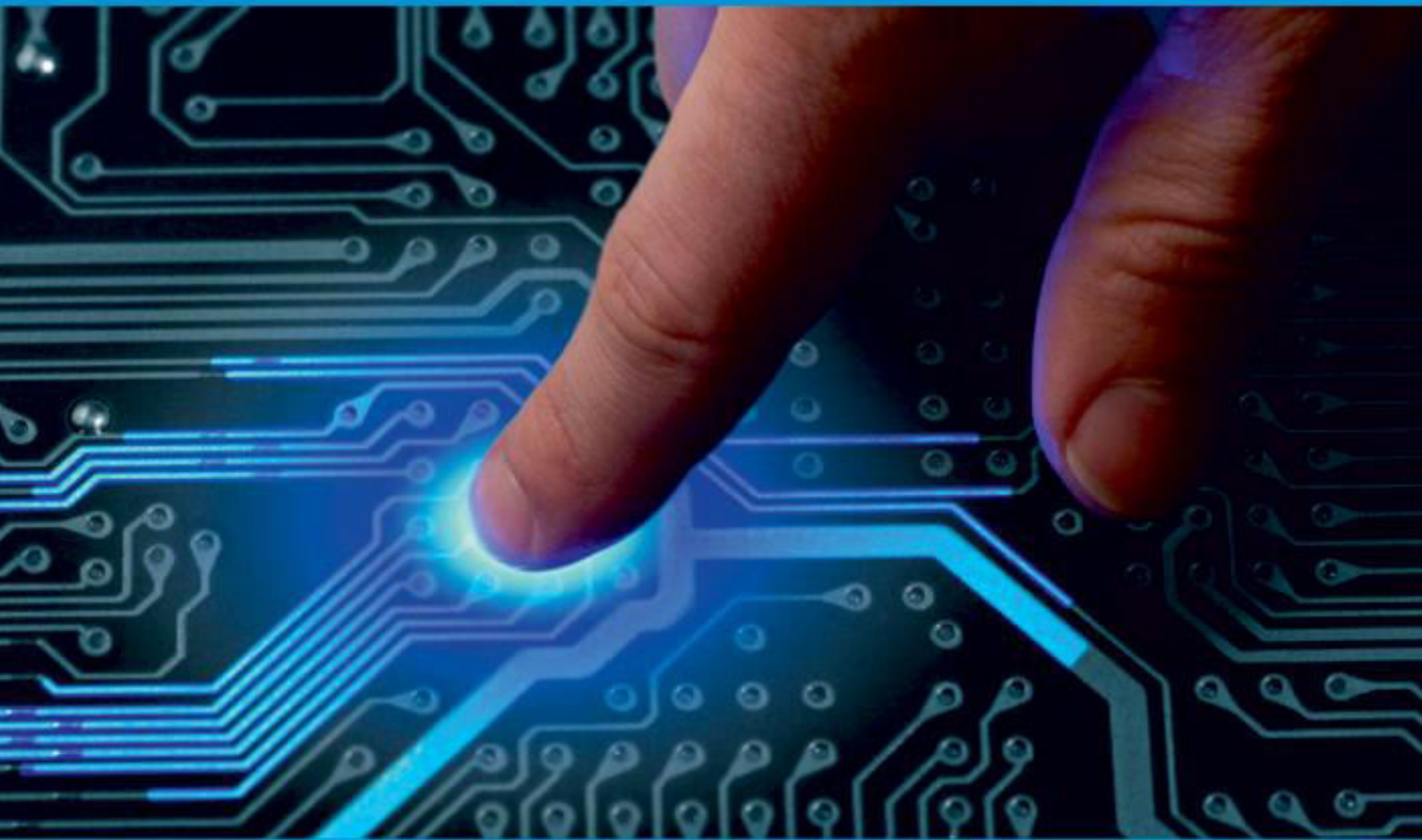




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An Automated Greenhouse System Using Internet of Things

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ABSTRACT: Greenhouses are climate controlled structures with walls and roof specially designed for offseason growing of plants. Most greenhouse systems use manual systems for monitoring the temperature and humidity which can cause discomfort to the worker as they are bound to visit the greenhouse every day and manually control them. Also, a lot of problems can occur as it affects the production rate because the temperature and humidity must be constantly monitored to ensure the good yield of the plants. Internet of Things is one of the latest advances in Information and Communication Technologies, providing global connectivity and management of sensors, devices, users with information. So the combination of IOT and embedded technology has helped in bringing solutions to many of the existing practical problems over the years. The sensors used here are YL69 moisture sensor and DHT11. From the data's received, MSP430G2 automatically controls Moisture, Temperature, Humidity efficiently inside the greenhouse by actuating an irrigating pipe, cooling fan, and sliding windows respectively according to the required conditions of the crops to achieve maximum growth and yield. The recorded temperature and humidity are stored in a cloud database (Thing Speak), and the results are displayed in a webpage, from where the user can view them directly.

I. INTRODUCTION

A greenhouse can be defined as a closed structure which is used to protect the plants from external factors such as climatic conditions, pollution, etc. It offers a sustainable and efficient development of the plants throughout the year. Basic factors affecting plant growth are sunlight, water content in soil, temperature, humidity etc. Numerous researchers have worked with water sprinkling and irrigation system. They opted for different methods for determining the soil moisture condition. The automated water supply system for urban residential areas showed that their system can be used to effectively manage water resource. Required physical factors are hard to control manually inside a greenhouse so there is a need for the automated system. Many smart irrigation systems have been proposed and devised through Evapotranspiration, thermal imaging, capacitive methods, and neutron scattering method and gypsum blocks are some of the technologies that enable moisture sensing. Capacitive sensors, however instantaneous are costly and need to be calibrated often with varying temperature and soil type. Internet of things is a growing technology of the hour which enables us to access different data's from any remote location as well. In our proposed system receives three parameters from the sensors and activates the actuators if the actual values are more than the threshold values and also stores these values in the cloud database enabling them to be accessed from anywhere, anytime. This also sheds light on the automatic control over the climatic conditions inside the greenhouse. There are different seasonal crops which can be grown only under certain conditions. Onions, garlic, shallots etc. are the winter crops which require cold conditions for their growth. Cucumbers, melons etc. are the summer crops which require moderate or hot climatic conditions. The prototype we used comprises of moisture sensors, temperature & humidity sensors, and MSP430 and water pipes to supply water from tank controlled by DC motors. Moisture sensors are installed near the roots and temperature & humidity sensor is installed further away to detect the temperature and humidity. These sensors send their data to the MSP430 to analyze the results. The MSP430 will turn the inlet valve on, to water the spinach, until the soil moisture value becomes greater than the threshold value. Inside the 2 greenhouse, if the temperature and humidity values are above the reference value, to maintain them to be within the threshold levels, sliding door will be opened and fan will be switched ON. The existing system consists of Manual Monitoring of the agricultural field parameters and the use of the GSM technology will take more time to get the required results. So in order to overcome that we have proposed more organized and automated monitoring of the crops by controlling different parameters inside the greenhouse. The Internet of Things is regarded as the third wave of information technology after Internet and mobile

communication network, which is characterized by more thorough sense and measure, more comprehensive interoperability and intelligence.

II. LITREATURE SURVEY

Gujar M, Rutuja Patil, Pragati Surve, Priyanka Patil. “GREENHOUSE AUTOMATION USING GSM”, 2018

The Monitoring and developing the GSM system is for use in greenhouse applications, where real time data of climate conditions and other environmental properties are sensed and control decisions are taken by monitoring systems they are modified by the automation system and sends SMS that what operation is performed by them to user. The architecture of a greenhouse monitoring system comprises of a set of sensor nodes and control unit that communicate with each sensor and collect local information to make necessary decisions about the physical environment. The temperature sensor LM35 sense the temperature and sends to SCU, it will amplify and send to control unit. The humidity sensor used to find the humidity of the greenhouse. The control units have the MCU to check the reading and make the fan ON or OFF. Then status of the Green House will send to the user mobile through GSM.

XIA GENG, QINGLEI ZHANG, et al “A Mobile Greenhouse Environment Monitoring System Based on the Internet of Things”, 2018

Knowledge of the environmental information of different spaces of large greenhouse is a prerequisite for effective control, and multipoint monitoring is therefore needed. In view of the problems of current greenhouse environmental monitoring, a mobile greenhouse environment monitoring system was designed based on the Internet of Things. A four-layer system architecture with outstanding motion control functions was constructed that uses mobile 4 acquisition rather than multiple sensing nodes to realize the automatic collection of greenhouse environmental information and capture pictures of the crops with low cost. In this study, a Raspberry Pi and an Arduino chip were combined for the first time in agriculture greenhouse environmental monitoring, with the former serving as the data server and the latter as the master chip for the mobile system. Firstly, the application layer server was deployed on the Raspberry Pi, secondly, due to its compact size and stable performance, Raspberry Pi and sensors etc. were all integrated into the mobile system, shortening the physical distance between the data acquisition end and the data processing end, and serial communication was used. In addition, a dedicated communication protocol with Cyclic Redundancy Check (CRC) checking was designed to reduce data loss at the transmission layer. The data was denoised using a limiting filtering algorithm and a weighted average filtering algorithm to improve quality of the data.

AHMED OUAMMI , OUMAIMA CHOUKAI , et al, “ A Decision Support Tool for the Optimal Monitoring of the Microclimate Environments of Connected Smart Greenhouse”,2020

in this paper, a comprehensive decision support tool based advanced monitoring system is developed to support transition to smart greenhouses for sustainable and clean food production. The decision framework aims to optimally control and manage the microclimate environments of smart connected greenhouses, where each greenhouse is defined as a self-water producing through an enhanced water desalination process. The main advantage of the current approach lies in the ability of the greenhouses to produce their water loads locally. This paper aims to develop an efficient decision tool able of performing specific monitoring and control functionalities to optimize the operation of the greenhouses where the aim is the energy and water savings. A decision model is 5 implemented for the precise regulation and control of the indoor microclimate defining the optimal growth conditions for the crops. Furthermore, a predictive algorithm is developed to simulate in real time the operation of the greenhouses under various conditions, to assess the response of the system to storage dynamics and renewable sources, as well to control the complex indoor microclimate, energy and water flows, as well to optimize the crops growth.

AHMAD F. SUBAHI AND KHEIR EDDINE BOUAZZA, “An Intelligent IOTBased System Design for Controlling and Monitoring Greenhouse Temperature”, 2020

The Kingdom of Saudi Arabia is known for its extreme climate where temperatures can exceed 50 °C, especially in summer. Improving agricultural production can only be achieved using innovative environmentally suitable solutions and modern agricultural technologies. Using Internet of Things (IOT) technologies in greenhouse farming allows reduction of the immediate impact of external climatic conditions. In this paper, a highly scalable intelligent system controlling, and monitoring greenhouse temperature using IOT technologies is introduced. The first objective of this system is to monitor the greenhouse environment and control the internal temperature to reduce consumed energy while maintaining good conditions that improve productivity. A Petri Nets (PN) model is used to achieve both monitoring of the greenhouse environment and generating the suitable reference temperature which is sent later to a temperature regulation block. The second objective is to provide an Energy-Efficient (EE) scalable system design that handles

massive amounts of IOT big data captured from sensors using a dynamic graph data model to be used for future analysis and prediction of production, crop growth rate, energy consumption and other related issues.

M. Lavanya, Sujatha Srinivasan, “A survey on agriculture and greenhouse monitoring using IOT and WSN”, 2018

Due to the increase in population, demand for food to meet day-today requirements is also growing, on the other hand drastic changes of climate and water scarcity, availability of agricultural land is replaced mostly by corporate buildings and apartments particularly in metropolitan cities. Due to the increase of vehicles, the pollution level is increasing day by day. Many of these issues should not destroy the backbone of India which is nothing but agriculture. Apart from all the above issues the real challenge lies in cultivation of crops which gives more yield with the available space, some new practices, some new methods has to be followed. An ideal solution is to convert our home terrace or backyard in to a greenhouse.

Harshida Sukhanandi, Kaushal I Doshi, “Analyses on monitoring and controlling using GSM module”, December-2014

The current growth trend of the human population, together with the evolution of consumption patterns, increasing demand and food waste are placing unprecedented pressure on agricultural systems and natural resources. Therefore, the supply of food is one of the greatest challenges that humankind must face in the twenty-first century. Agricultural ecosystems are the principal providers of food. Currently, approximately 275 million hectares are dedicated to irrigated crops throughout the world. This area is growing at an average annual rate of 1.3%. This accounts for just 23% of farmed land; however, 45% of total food production is obtained through these types of crops. In order to satisfy the food demand in 2050, world production must increase by 70%. This predicted increase in world food production implies an extension of farmed land or an intensification of the production on the land currently farmed. In low production scenarios, an increase of 53% in the consumption of water resources would be required together with an increase of 38% of farmed land throughout the world in order to satisfy the food demand target in 2050. The main disadvantage of expanding agriculture is the availability of land, obliging the transformation of land uses, which translates into a loss of natural ecosystems. Therefore, converting land into farmland is the second greatest global threat to preserving biodiversity, due to the deforestation processes involved.

Varsha Modani, Ravindra Paitu, Pooja Puri, Niraj Kapse, “IOT based green monitoring system”,2019

We live in a modern 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 fully-fledged use, perhaps because of several reasons. Growth in agricultural sector is necessary for the development of economic condition of the country. Unfortunately, many farmers still use the traditional methods of farming which results in low yielding of crops. But wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been improved. Hence there is need to implement modern science and technology in the agriculture sector for increasing the yield. Environmental condition has been significant effect on the plant growth. The greenhouse structure represents both the barrier to direct contact to the external environment and the containment of the internal environment to be controlled. Due to global warming, the environment cycles are changing, affecting variation of temperature in all regions.

Jose A. Aznar-Sanchez, Juan F. Velasco-Munoz, Belen Lopez-Felices, Isabel M.Roman-Sanchez, “An analysis of global research on greenhouse technology”, December-2019

Gardening is one of the popular hobbies among the people in the midst of busy work culture and urban life style. Gardening seems to release the stress, healthy spending of the leisure time effectively. But the apartment living has no free space for gardening. As a result, small scale greenhouse is now the hottest trend in the century. Greenhouse is a structure that the user used to grow the plants. It is built with a specific need for the type of plant they wish to grow. So the structure varies depending on type of plant and scale of size. Although it creates a perfect environment for plants, it needs human care to control the optimum status of the house such as ventilation. Automation is process control of industrial machinery and process thereby replacing human operators. It helps to monitor the situation, when they are not at home. The main aim of this paper is to minimize the human care needed for the plant by automating the greenhouse and monitor the greenhouse environment status. A single unit of the greenhouse structure prototype has been constructed and integrated with the sensors. Continuous monitoring of these environmental variables gives information to the grower to better understand, how each factor affects growth and how to manage maximal crop productiveness.



Anju, Satish Kumar, “Green House Automation Using ZigBee and Smart Phone”, 2017

Mostly the world & people are dependent on agriculture & their productivity. Because there is a lot of fluctuation in atmosphere, people cannot predict that deviation & not obtain enough productivity. So there is requirement of technology in that direction which provide to fulfill the criteria for crop to develop & corresponding atmospheric parameter condition. Greenhouse also helpful in nursery for orchid breeding, vegetables, fruits, and transplants. Idea of growing plants in environmentally controlled areas has existed since roman times. In the 13th century, greenhouses were built in Italy. They were originally called Giardini botanic. Then, in 1450, sanga yorok written description of greenhouses which was designed to regulate the temperature and humidity requirements of plants & crops. As the time passed, every country adopts the greenhouse system with some enhancement. With the help of greenhouse, it may enable to grown a selected crop through the year. Therefore, greenhouse monitoring & controlling become essential this days.

V.Sagar Reddy, Gujjula Ramya, V.Moneesh Reddy, “Green house environment monitoring and automation using Intel Galileo gen and IOT”, May-2019

A greenhouse (also called a glasshouse) is a building or complex in which plants are grown .our aim is optimization of environmental conditions for better plant growth. The aim of the paper is to control the devices or equipment’s from the remote place through a web page and I am going to make our own Visual Basic software Web server which will communicate with the other devices such as Smart mobile phones PC’s etc. The devices will communicate with server using synchronizing software .This software will keep all the devices in synch with the server. The main advantage of this technique is that the devices connected to the web server need not store the offline data or have the software required to view the data. In this way the devices connected need not store or run the software whenever they want to view the data. All the required software and 10 the data are stored in the web server and the Client devices need not store the data neither the software. Also the devices can view the required data anywhere from the world as these devices are connected via Internet. The nature and complexity of the software systems had changed significantly in the last 30 years. The webserver is connected to LAN or Internet. The client or a person on the PC is also connected to same LAN or Internet The sensors attached to the greenhouse are interconnected to exchange houses various parameters required to determine efficient crop yield like Temperature, Soil Moisture, Light Intensity, Humidity are sensed and sent to the Arm microcontroller for monitoring and control through ZigBee In some of the countries, most of existing greenhouse control systems used wired communication, which faces with wiring problem. The wiring problem includes high cost, installation and maintenance difficulties and that broken node is likely to cause the entire system out of work. By using wireless communication we can overcome these kinds of problems. The wireless communication does not require wiring, it’s low cost and easy to maintain.

III. METHODOLOGY

EXISTING SYSTEM

The Existing System focusing on GSM based system is used for monitoring an agriculture land. The Monitoring and developing the GSM system is for use in greenhouse applications, where real time data of climate conditions and other environmental properties are sensed and control decisions are taken by monitoring systems they are modified by the automation system and sends SMS that what operation is performed by them to user. The architecture of a greenhouse monitoring system comprises of a set of sensor nodes and control unit that communicate with each sensor and collect local information to make necessary decisions about the physical environment. The temperature sensor LM35 sense the temperature and sends to SCU, it will amplify and send to control unit. The humidity sensor used to find the humidity of the greenhouse. The control unit has the MCU to check the reading and make the fan ON or OFF. Then status of the Green House will send to the user mobile through GSM. Soil moisture sensor is used for monitoring land soil quality. In case of low soil quality only inform former using GSM. This system former cannot monitor individual plants, so because of that growth of the plants is decreased.

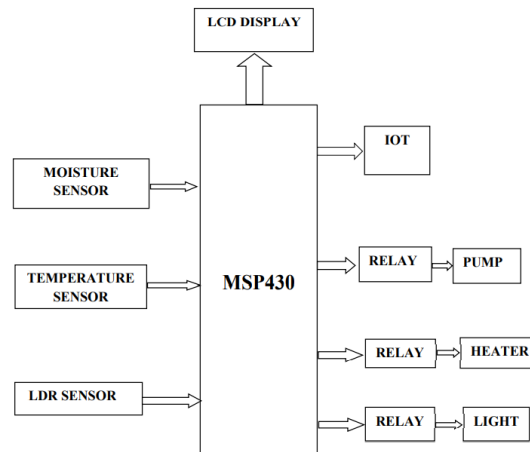
Drawbacks: • GSM based system only monitor single person. • We cannot monitor entire land. • This system only monitoring not control.

PROPOSED SYSTEM

The main objective of this project is to monitoring and control the green house using internet of thinks (IOT). In this project sensor node is a MSP430. The temperature sensor is used for atmosphere temperature. The Moisture sensor used to measure the moisture level in soil. The LDR sensor is used for the measurement light illumination level. Then the amplified voltage signal is given to MSP430. After receiving the signal based on the values our MSP 430 is control the corresponding devices 12v pump for soil moisture, heater for temperature sensor, and light for LDR sensor. And also this value updated to the server too. IOT and MSP430 based Greenhouse Environment Monitoring and controlling

project use four sensors to detect the Temperature, Light, Humidity and Soil moisture in the Greenhouse. Temperature Sensor is used to detect the temperature inside the greenhouse. Reading from the sensor is sent to the microcontroller. The microcontroller is connected to different relays. One of the relays is connected to a blower. If the temperature is above or below the threshold value, the microcontroller would send signals to turn ON the Fan. Light Sensor is used to detect the amount of sunlight inside the greenhouse. Reading from the sensor is sent to the microcontroller. If the Sunlight is above the threshold value, the microcontroller would send signals to turn ON the relay which would, in real-time, is a 'shade' that would reduce the amount of Sunlight. For demo purposes, we have connected a DC motor to replicate a Shade. Similarly, the Humidity sensor is used to detect the humidity value and the Soil moisture sensor is used to detect the soil moisture. If the humidity value detected by the sensor is above the threshold value OR if the soil moisture reduces, the microcontroller would turn on the blower to decrease the humidity and will open the water outlet to increase 13 the moisture in the soil. For demo purposes, we have connected a DC motor in place of blower and water outlet. At the same time, data regarding these parameters are sent to the IOT module the data sent to the IOT is sent at regular intervals irrespective of any threshold mismatch found. Data, which is sensed by these sensors, is then sent to the IOT. The Pre-requisite for this project is that the Wi-Fi module should be connected to a Wi-Fi zone or a hotspot. This project is also implement ted without the IOT module. We have used the GSM module.

BLOCK DIAGRAM:



HARDWARE REQUIREMENTS

MSP430

MSP430 Launchpad is a development board which can be used to design all Arduino based applications since both have similar capabilities and features. Similar to Arduino being developed on AVR controllers, the MSP430 launch pad is developed on TI MSP430 microcontrollers. This device can be used to develop low end applications and not high end applications, as it does not have high processing power like Raspberry pi. FIG 2:MSP430 Development Board 15 There are few ports present on the board as shown in the MSP430 pinout and the functions of these ports are described below.

Name	Pin	Function
GPIO pins	P1.0 to P1.7 & P2.0 to P2.5	These are the input/output pins of the microcontroller (placed in the socket) given out of the board for interfacing.
Button	P1.3	Can be used for general purpose interfacing during operation.
LEDs	P1.0 & P1.6	Can be used for general purpose indication during operation.
Reset	Connected to RESET pin of microcontroller	If pressed the microcontroller will reset.
Power	Connected Three pin jack at the bottom	Can be used to connect eternal power sources after programming.
Crystal pads	Solder joints adjacent to controller	A crystal oscillator can be soldered here for providing more accurate clock source.
eZ430 connector	Six pin connector	Provides a bridge between Emulator board and Microcontroller breakout board. Can be disconnected to isolate both sections of the PCB.
Programming port	USB connector at the top	The device will be connected to PC (For programming and power) using this port.

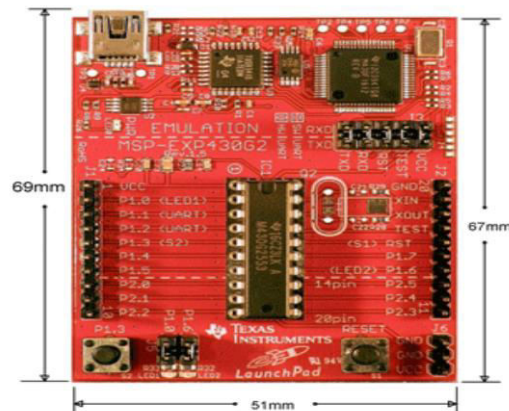


FIG 2: MSP430 Development Board

MSP430 Launchpad Usage

Similar to Arduino we need IDE software for interfacing the board to PC and programming the microcontroller seated in it. There are two IDE software available for the MSP430 Launchpad and the link of both are given below. • http://processors.wiki.ti.com/index.php/Download_CCS • <https://energia.nu/download/> In both IDE using Energia is easier, as the software is developed based on Arduino IDE and they share similar programming feel. So for those who are familiar with Arduino will feel Energia IDE similar and helpful. Once you download the IDE software install it in your PC and do it with administrator rights for avoiding future troubles. Run the installed program and connect the development board to the PC using the cable provided along with the kit. The PC will detect the board automatically after connecting. Once detection is done go to the example programs in the IDE and choose blinking program to execute. Once it is done the IDE will debug the blink program for error and after successful compilation the program will be transferred to microcontroller in the board. Once the program is transferred, the microcontroller executes the blink program saved in its flash memory and we will see the LED present in the board blinking. So with that we have successfully programmed the controller via USB interface and in the similar way we can write the other programs in the IDE and dump these programs in the controller after compilation.

MSP430G2 Launchpad Contents

When you purchase the MSP430G2 Launchpad Development Tool from TI or any other local vendor you will get the following materials included in your Box. The complete contents are also shown in the picture below. Also note that this is applicable as on 2018 the earlier and future versions might have different Contents MSP-EXP430G2 Development Board MSP430G2452 and MSP430G2553 Microcontrollers Mini USB cable Micro Crystal Oscillator (32.7 kHz)

MSP-EXP430G2 Development Board

The gorgeous red colour board is the MSP-EXP430G2 Development Board. This board can program TI Microcontrollers that fall under the MSP430 series. The main purpose of this board is to upload code from the computer to the MCU and read serial data from the MCU for debugging purpose. It also provides the pin-out for each pin of the MCU and also two LEDs and a push button to make development easy. The board has evolved a lot since its launch and the one shown below is the MSP_EXP430G2 Rev1.5. To know about the function of each jumper and button on the board

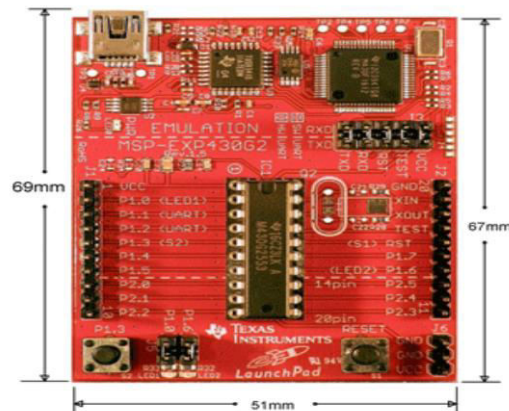


FIG 2: MSP430 Development Board

MSP430G2452 and MSP430G2553 Microcontrollers: As told earlier the MSP430 Development Board can be used to program Microcontrollers that fall under the MSP430 Value line series. But, with this development kit, TI provides us two Microcontrollers from the MSP430 series which are the MSP430G2452 and the MSP430G2553. Both are 20 Pin DIP IC's with decent performance. By default, the MSP430G2553 will be fixed to the IC socket of your Development board and the MSP430G2452 will be provided separately. The technical specification of both the MCUs are tabulated below 19 The MSP430G2553 has better specifications than the other, it also has a UART module which would be very handy while debugging using Energia. Hence in this series of tutorials, we will be using the MSP430G2553 to explore all the functionalities of this Development kit.

Mini USB cable:

The mini USB cable is used to connect the board the Computer when a program has uploaded the data (in form of hex code) will flow from the computer to the board through this cable. Also during debugging (Serial Monitor), the data from the MCU will be received via this cable. This cable also provides power to the board, so you can even use a mobile charger to power your board through this cable after uploading the program.

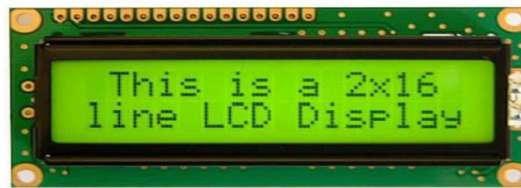
Micro Crystal Oscillator TI Also provides a 32 kHz micro crystal Oscillator along with the Development Kit. This Crystal can be soldered to the Board but it is completely optional. 20 Because the MSP430G2553 IC has an internal Oscillator of 16MHz which should be sufficient for us to get started.

Powering and Testing your Development Board

Before we start anything TI would have already uploaded a sample Program on your MSP430G2553 Microcontroller, so let us power the board and check if it is working. You can power board through the mini USB jack and once you do it, you should notice the LEDs (red and green) at the bottom left corner of your board glowing alternatively. You can then press the push button connected to P1.3 to check if the internal temperature sensor is working. Yes, the MSP2553 has an internal temperature sensor, after pressing the button just rub your fingers to warm it up and place it on the IC you can notice the Red LED turns on to indicate the rise in temperature. Cool!! Right?? Okay now, let us move on to the Software Environment.

MSP430 Features and Electrical characteristics

- Dip socket for easy plug-in or removal of microcontroller
- Energy trace technology available for ultra-low-power debugging
- One button and two LEDs for user interaction
- USB debugging and programming interface featuring a driverless installation
- Available UART serial communication with up to 9600 Baud
- Supports MSP430G2xx2, MSP430G2xx3, and MSP430F20xx devices in PDIP14 or PDIP20 packages
- Hardware reset button available on board
- Operating voltage range: 5V



LCD

Liquid Crystal Display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs do not emit light directly. They are used in a wide range of applications including: computer monitors, television, instrument panels, aircraft cockpit displays, signage, etc. They are common in consumer devices such as video players, gaming devices, clocks, watches, calculators, and telephones. LCDs have displaced cathode ray tube (CRT) displays in most applications. They are usually more compact, lightweight, portable, less expensive, more reliable, and easier on the eyes. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they cannot suffer image burn-in. LCDs are more energy efficient and offer safer disposal than CRTs. Its low electrical power consumption enables it to be used in battery-powered electronic equipment. It is an electronically-modulated optical device made up of any number of pixels filled with liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in color or monochrome. The earliest discovery leading to the development of LCD technology, the discovery of liquid crystals, dates from 1888. By 2008, worldwide sales of televisions with LCD screens had surpassed the sale of CRT units.

TEMPERATURE SENSOR:

A thermistor is a type of resistor whose resistance varies with temperature. The word is a portmanteau of thermal and resistor. Thermistors are widely used as inrush current limiters, temperature sensors, self-resetting overcurrent protectors, and self-regulating heating elements. Thermistors differ from resistance temperature detectors (RTD) in that the material used in a thermistor is generally a ceramic or polymer, while RTDs use pure metals. The temperature response is also different; RTDs are useful over larger temperature ranges, while thermistors typically achieve a higher precision within a limited temperature range [usually $-90\text{ }^{\circ}\text{C}$ to $130\text{ }^{\circ}\text{C}$]. Basic operation 25 Thermistor symbol Assuming, as a first-order approximation, that the relationship between resistance and temperature is linear, then: Where, ΔR = change in resistance ΔT = change in temperature k = first-order temperature coefficient of resistance Thermistors can be classified into two types, depending on the sign of k . If k is positive, the resistance increases with increasing temperature, and the device is called a positive temperature coefficient (PTC) thermistor, or positron. If k is negative, the resistance decreases with increasing temperature, and the device is called a negative temperature coefficient (NTC) thermistor. Resistors that are not thermistors are designed to have a k as close to zero as possible, so that their resistance remains nearly constant over a wide temperature range. Instead of the temperature coefficient k , sometimes the temperature coefficient of resistance α (alpha) or αT is used. It is defined as 26 For example, for the common PT100 sensor, $\alpha = 0.00385$ or $0.385\text{ } \%/^{\circ}\text{C}$. This αT coefficient should not be confused with the α parameter below.

Agriculture

Measuring soil moisture is important in agriculture to help farmers manage their irrigation systems more efficiently. Not only are farmers able to generally use less water to grow a crop, they are able to increase yields and the quality of the crop by better management of soil moisture during critical plant growth stages. Besides agriculture, there are many other disciplines using soil moisture sensors. Golf courses are now using sensors to increase the efficiencies of their irrigation systems to prevent over watering and leaching of fertilizers and other chemicals offsite.

LDR SENSOR

LDR sensor:

An LDR is a component that has a (variable) resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits.

7 RELAY A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much

as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification. FIG 8: RELAY Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay. The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT. The relay's switch connections are usually labeled COM, NC and NO: • COM = Common, always connect to this; it is the moving part of the switch. • NC = Normally Closed, COM is connected to this when the relay coil is off. • NO = Normally Open, COM is connected to this when the relay coil is on. 4.8 POWER SUPPLY: The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units. FIG 9: Block diagram (Power supply) 4.9 IC voltage regulators Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milliamperes to tens of amperes, corresponding to power ratings from milliwatts to tens of watts FIG 10: VOLTAGE REGULATOR CIRCUIT TRANSFORMER RECTIFIER FILTER IC REGULATOR LOAD 31 A fixed three-terminal voltage regulator has an unregulated dc input voltage, V_i , applied to one input terminal, a regulated dc output voltage, V_o , from a second terminal, with the third terminal connected to ground. The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts. • For ICs, microcontroller, LCD ----- 5 volts For alarm circuit, op-amp, relay circuits ----- 12 volts

MOISTURE SENSOR:

MOISTURE SENSOR CIRCUIT 32 Circuit description: This circuit is designed to measure the MOISTURE level in the atmosphere air. The MOISTURE sensor is used for the measurement device. The MOISTURE sensor consists of a multivibrator in which the capacitance is varied depends on the MOISTURE level. So the multivibrator produces the varying pulse signal which is converted into corresponding voltage signal. The voltage signal is given to inverting input terminal of the comparator. The reference voltage is given to non-inverting input terminal. The comparator is designed by the LM 741 operational amplifier. The comparator is compared with reference MOISTURE level and delivered the corresponding error voltage at its output which is given to next stage of gain amplifier in which the variable resistor is connected in the feedback path by adjusting the resistor we can get the desired gain. Then the final voltage is given to microcontroller or other circuit in order to find the MOISTURE level in the atmosphere. 4.11 TRANSFORMER The potential transformer will step down the power supply voltage (0- 230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op- amp. The advantages of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.

BRIDGE RECTIFIER

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow. The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3. One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the

applied voltage, this bridge rectifier is a full-wave rectifier. 34 One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit. This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts. The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 vOlts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

SOFTWARE DESCRIPTIONS

The MSP-EXP430G2 is a Development Tool Launchpad provided by the Texas Instruments to learn and practice on how to use their Microcontrollers. This board falls under the MSP430 Value Line category where we can program all the MSP430 series Microcontrollers. This beautiful shiny Red board is fascinating to learn just because of the very fact that it belongs to TI (Texas Instruments). Learning how to use TI Microcontrollers would defiantly be a mighty tool up in our sleeve because TI is really huge and has a wide verity of MCU's to choose from for a very less competitive price. In this series of tutorials, we will learn about this MSP430G2 Launchpad and how to program it. Using this Launchpad we can work with MSP430 Microcontrollers which offers 16-bit performance with an operational speed up to 16MHz. The tutorials are written for very beginners in electronics and hence every topic would be briefed as crisp as possible. The hardware required for these tutorials would be a normal computer and the MSP430 Value Line Launchpad Development Toolkit with few other basic electronics components that you can easily find in your local electronics hardware shop. So without any further ado let's dive into the Development Tool and check out what's included in the box and how to use them. We will be able to blink an LED at the end of this tutorial.

Downloading and launching the Energia IDE:

As said earlier the Energia is an open source and free Development environment, and it can be downloaded from official website. Select the Version based on your operating system, for windows you should notice a ZIP file being downloaded. After downloading the ZIP just extract it on your preferred location 36 and open the folder. You find the application named Energia. Launch it and it should Look something like below. Arduino users don't be surprised as it just might look like your Arduino IDE has dressed up like a Santa to appear as Energia. The resemblance of both Arduino and Energia are same because they both are built on top of a platform called Processing.

Blinking an LED on MSP430G2

Now, that we are ready with our hardware and software let us try a basic example program from Energia to blink the on board LED. Before we start programming we have to know the pin names of each pin on our MSPG2553 IC. Because we will be using these names while programming our board. The 37 following picture from the Energia website will help us understand the name and functionality of each pin. Based on the Revision of your board the image might vary slightly. Understanding the Example Blink Program: Let's, start with the Example blink program which will blink the LED1 (red color) which is connected to the P1.0 pin of your Microcontroller. The LED and its marking on my board is in the below picture. Blinking an LED on MSP430G2 The following program will appear on your IDE #define LED RED_LED

Programming Software (IDE) for MSP430 Launchpad

Texas Instruments allows us to program their Microcontrollers through a variety of Environments. The Official one is the Code Composer Studio commonly known as the CCS. This software is also free but using it is requires some minimal level of experience with Microcontrollers. Since this series of tutorials are targeted for absolute beginners we use another Development Environment called Energia. Energia is an Open source and free Environment that enables us to program the TI Microcontrollers easily. The main aim of Energia is to make programming TI MCU's as easy as programming in Arduino. So Energia is an Equivalent for Arduino that supports Texas Instruments Microcontrollers. People who have used Arduino will agree more on this once they download and launch the energia IDE.

IV. RESULT AND DISCUSSION

HARDWARE OUTPUT The hardware output of the project is shown in the figure as given below. We designed this project to monitor and control the environmental parameters. We got result based on effective management of

greenhouse environment by IOT Automatic controlling process is fully done based on coding. The sensor senses the environmental conditions and based on the requirement of crops the instruction will send to farmer through IOT. FIG 13: HARDWARE OUTPUT 40 6.2 SOFTWARE OUTPUT

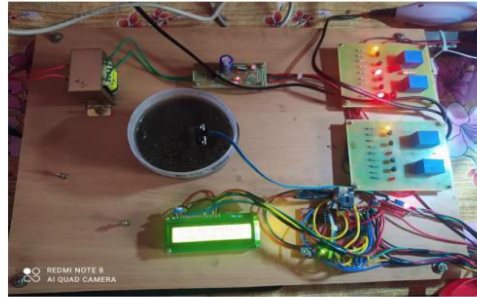


FIG 13: HARDWARE OUTPUT

SOFTWARE OUTPUT

Green house monitoring	
Temperature :	100
Moisture :	147
LDR :	080
Status :	NORMAL

V. CONCLUSION

The greenhouse monitoring system based on internet of things can give accuracy in an efficient way and continuous monitoring of greenhouse environment has been done. The proposed system is building greenhouse monitoring system based on internet of things in which the software for the development board with sensor has been developed with the embedded system and communication technology. The results contain temperature, relative humidity and carbon-dioxide from the sensor. The result of this project shows that a new proposed system for green house monitoring has a great advantage in remote monitoring also. The implementation of the internet of things also occurs in a more secure fashion. Thus it has a broad application prospect and industrial value.

FUTURE SCOPE:

This Project only gave a little advancement over traditional way i.e. monitoring plant parameters like humidity ,temperature, soil moisture, illumination within the plant premises and providing automation for them and also monitoring them at distant places using IOT .But in future not only monitoring plant parameters but we can also monitor the internal health conditioning of the plant through image processing ,it means we can check which part of the plant is having dead cells, and which part of the plant is healthy. In future using different technology we can also know how much amount of chemicals is required for certain plant growth.

APPENDIX

```
// the setup routine runs once when you press reset: Void setup () { Pin Mode (LED, OUTPUT); // initialize the digital pin as an output. } // the loop routine runs over and over again forever: Void loop () { Digital Write (LED, HIGH); // turn the LED on (HIGH is the voltage level) Delay (1000); // wait for a second Digital Write (LED, LOW); // turn the LED off by making the voltage LOW Delay (1000); // wait for a sec Let’s break the above code into line by line and see what it actually means, but before that let us understand the basic programming structure of Energia. Every Energia Program will have two mandatory functions, they are void Setup () and void Loop (). The code present inside the void Setup () will be executed only once and the program present inside the void Loop () will be executed for ever. All the pin declarations and initializations will be done inside the Setup () and the main program which has to be executed forever will be written inside the void Loop (). 43 You can think of void Loop () as an equivalent to while (1) (Infinite while loop). With this in mind let us start exploring above code line by line. The first line of the program is called macros. The Energia IDE is smart enough to understand words like RED_LED, GREEN_LED, TEMP_SENSOR and much more. These are nothing but the name of the pins to which the hardware is connected to. This is possible because
```




the Red and Green LEDs are hardwired on our board and hence the MCU pin to which it's connected to is known. Again for the comfort of programming we use a Macro which says that instead of using the name "RED_LED" in my program I will use only "LED" by using the #define as shown in the below line. #define LED RED_LED Next we come into our void setup() function, this is the place where we tell our MCU which pins should be used as input pins and which should be used as output pins. In our program we only use a LED and it is an Output device, so we declare it to be an output pin like shown below Void setup () { Pin Mode (LED, OUTPUT); // initialize the digital pin as an output. } The line pin Mode () is used to say that I am going to declare input/output pins and then we say the name and type of the pin in bracket. Here the name of the pin is LED and the type of the pin OUTPUT. There are many ways in which we can call a pin. In this example we have named it LED using the #define macro, but we can also name it using its original name. 44 Like in our case the LED is connected to the 2nd pin of the MCU and that pin is named as P1.0, Refer the pin-out picture above to see the names. So instead of calling it as LED we can also call it by the following Pin Mode (LED, OUTPUT); //Instead of this we can also Pin Mode (2, OUTPUT); //Call by pin number Pin Mode (P1.0, OUTPUT); //Call by pin name Next lets step down to the void Loop () function. Here we have to write the code to blink the LED. To blink an LED we have to turn it ON wait for a pre-defined time and then turn it OFF and again wait for a pre-defined time and again the cycle continues. To turn a pin ON or OFF in Energia we have to use the digital Write () function. The parameters pass the name of the pin and its state in the brackets like shown below Digital Write (LED, HIGH); // turn the LED on (HIGH is the voltage level) Here the name of the pin is LED and the state is HIGH, similarly you can also turn it off by using the state LOW like below Digital Write (LED, LOW); // turn the LED off by making the voltage LOW As said earlier the name of the pin can be anything like LED, 2 or P1.0 for this pin. So other forms like Digital Write (2, LOW); digital Write (P1.0, LOW); Are also possible. 45 Now, that we have learnt how to turn ON or OFF the pins. We will learn how to introduce delay using the delay (). We can specify delay by passing a value inside the brackets in terms of milliseconds Delay (1000); // wait for a second So let's combine all these into our while loop. We should turn ON the LED wait for 1sec, then turn it OFF and again wait for 1sec. This cycle should continue forever. So our program will look something like this below Void loop () { Digital Write (LED, HIGH); // turn the LED on (HIGH is the voltage level) Delay (1000); // wait for a second Digital Write (LED, LOW); // turn the LED off by making the voltage LOW Delay (1000); // wait for a second } Compiling and uploading your Blink Program: The next step would be to upload this program to our MSP board. To do this simply connect your board to the computer using the USB mini cable provided and wait for some time. The drivers for the board should start installing automatically. Then Open your device manager and under the COM ports option you should see your Board name like shown below 46 Once your board is discovered, make a note to which COM port it is connected to. Mine is connected to Port 4 here. Then go back to the Energia IDE and select Tools -> Port and select the same port I have selected COM4 for me. Then again go to Tools -> Boards and select the MSP-EXP430G2553LP. Once done you should notice the following at the bottom right corner of your Energia IDE. Now click on the upload icon on the top left corner (use the video at the bottom of this page if you are an absolute beginner) and your program should start uploading to your board. If everything works fine you should notice the "Done uploading" message appearing on your IDE as shown below.

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