ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Zigbee Communication Based Irrigation System

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Abstract :
Agriculture plays the major role in economics and survival of people in India. Nowadays Indian agriculture faces a two major problem. They are as follows; know government has promoted a free supply of electricity for farmers to run their motors and pumps for irrigation purpose. But it is found that the farmers misusing the electricity to run their home appliances such as radio, TV, fans, etc. This misuse of electricity has brought a considerable problem for government to supply free electricity. Since most of the farmers have less knowledge about the nature of their soil and its fertility, they cannot find the right seeds for their fields to be sowed. To avoid these problems a microcontroller based embedded system has been proposed in this project. In transmitter we are using zigbee for the communication purpose for the irrigation system her we implementing the soil sensor which can be senses the soil by detection of soil it will give the information to the controller and zigbee can transfers the information to the other zigbee by using the that information the receiving section can take the information and perform the task.In receiving section we are including the motor for rotating the motor and controlling the motor. By using this time saving and energy saving. Using Zigbee technology we transfer the data and also recives the data at time in both ways. Nothing but transreceiver.

Introduction:
Embedded systems are electronic devices that incorporate microprocessors with in Their implementations. The main purposes of the microprocessors are to simplify the system design and provide flexibility. Having a microprocessor in the device means that removing the bugs, making modifications, or adding new features are only matters of rewriting the software that controls the device. Or in other words embedded computer systems are electronic systems that include a microcomputer to perform a specific dedicated application. The computer is hidden inside these products.

Embedded systems are ubiquitous. Every week millions of tiny computer chips come pouring out of factories finding their way into our everyday products.Embedded systems are self-contained programs that are embedded within a piece of hardware. Whereas a regular computer has many different applications and software that can be applied to various tasks, embedded systems are usually set to a specific task that cannot be altered without physically manipulating the circuitry. Another way to think of an embedded system is as a computer system that is created with optimal efficiency, thereby allowing it to complete specific functions as quickly as possible. Embedded systems designers usually have a significant grasp of hardware technologies. They used specific programming languages and software to develop embedded systems and manipulate the equipment. When searching online, companies offer embedded systems development kits and other embedded systems tools for use by engineers and businesses.

Embedded systems technologies are usually fairly expensive due to the necessary development time and built in efficiencies, but they are also highly valued in specific industries. Smaller businesses may wish to hire a consultant to determine what sort of embedded systems will add value to your organization. An embedded system is a system which is going to do a predefined specified task is the embedded system and is even defined as combination of both software and hardware. A general-purpose definition of embedded systems is that they are devices used to control, monitor or assist the operation of equipment, machinery or plant. “Embedded” reflects the fact that they are an integral part of the system. At the other extreme a general-purpose computer may be used to control the operation of a large complex processing plant, and its presence will be obvious. embedded system has been proposed in this project. This proposed system recognizes whether the free electricity has been used other than electric motors for pumping water and if so electricity is being misused, it shuts the total supply.

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for the farmers through a tripping circuit. By using wireless networks can intimate the electricity board about these mal practices. This system also helps the farmers to find their soil fertility. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The development of the automated irrigation system based on microcontrollers and wireless communication at experimental scale within rural areas is presented. The aim of the implementation was to demonstrate that the automatic irrigation can be used to reduce water use. This gateway permits the automated activation of irrigation when the threshold values of soil moisture and temperature is reached. Communication between the sensor nodes and the data receiver is via the zigbee.

Pumps are essential in the water supply field, wooden pumps existed in the 1700s and these were used to empty the bilges of ships. They were made from bored logs with wooden pistons to create suction. Metal piston type pumps,driven by steam, were developed in the early to mid-1800s but it was not until the advent of electrically driven pumps that water system expansion became feasible on a large scale. Layne Bowler developed the first vertical turbine water pumps in 1894 and Jacuzzi developed the first submersible pumps in the 1920s. These manufacturing developments provided the hardware to allow the establishment of many New Hampshire public water systems in the very late 1800s(Hicks et al., 1971).

Automatic water pump controller is a series of functions to control the Automatic Water Pump Controller Circuit in a reservoir or water storage. The water level sensor is made with a metal plate mounted on the reservoir or water tank,with a sensor in the short to create the top level and a detection sensor for detecting long again made for the lower level and ground lines connected to the bottom of reservoirs or reservoir.In everyday life, there must be some physical elements that need to be controlled in order for them to perform their expected behaviours. A control system therefore can be defined as a device, or set of devices, that manages, commands, directs or regulates the behaviour of other device(s) or system(s). Consequently, automatic controlling involves designing a control system to function with minimal or no human interference. Intelligent systems are being used in a wide range of fields including from medical sciences to financial sciences, education, law, and so on. Several of them are embedded in the design of everyday devices. This paper aimed at presenting our project in embedding a control system into an automatic water pump controller. One of the motivations for this research was the need to bring a solution to the problem of water shortage in various places eliminating the major culprit; waste of water during pumping and dispensing into overhead thanks. We believe that creating a barrier to wastage will not only provide more financial gains and energy saving, but will also help the environment and water cycle which in turn ensures that we save water for our future.

SCOPE OF IMPROVEMENT:

The use of web interface will provide an excellent platform from which the system is developed. The portability of web interface technology means that the system could be controlled from anywhere in the world (if required). Different control mechanisms can be implemented depending on various types of crops. Also we can monitor the content of the soil.

Ease of use:

An embedded system is a system which is going to do a predefined specified task is the embedded system and is even defined as combination of both software and hardware. A general-purpose definition of embedded systems is that they are devices used to control, monitor or assist the operation of equipment, machinery or plant. “Embedded” reflects the fact that they are an integral part of the system. At the other extreme a general-purpose computer may be used to control the operation of a large complex processing plant, and its presence will be obvious. All embedded systems are including computers or microprocessors. Some of these computers are however very simple systems as compared with a personal computer. The very simplest embedded systems are capable of performing only a single function or set of functions to meet a single predetermined purpose. In more complex systems an application program that enables the embedded system to be used for a particular purpose in a specific application determines the functioning of the embedded system. The ability to have programs means that the same embedded system can be used for a variety of different purposes. In some cases a microprocessor may be designed in such a way that application software for a particular purpose can be added to the basic software in a second process, after which it is not possible to make further changes.

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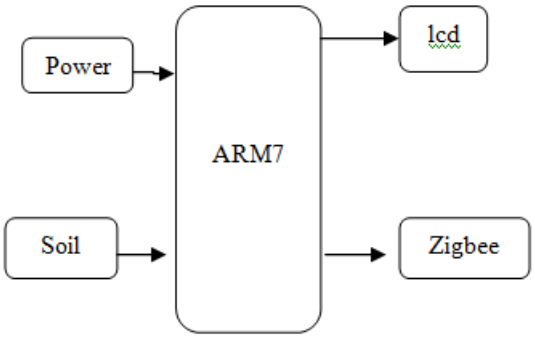
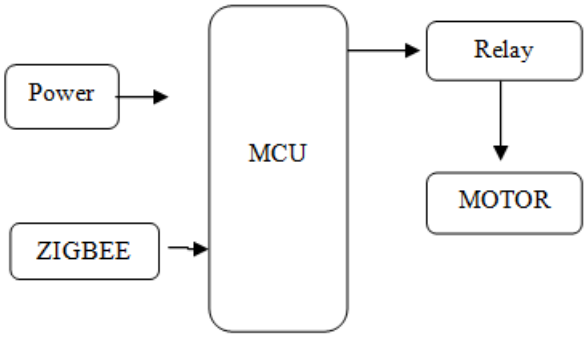
The applications software on such processors is sometimes referred to as firmware.

BLOCK DIAGRAM:

TRANSMITTER:

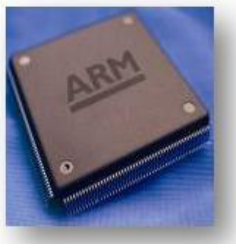


RECEIVER:



Arm processor review:

ARM stands for Advanced RISC Machines. It is a 32 bit processor core, used for high end application. It is widely used in Advanced Robotic Applications. It performs number of instruction in a single cycle compare with other controllers it have advanced features. The Arm CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/42/44/46/48 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, SSP to I2C-bus and on-chip SRAM of 8 kB up to 40 kB, make these devices very well suited for communication gateways and protocol converters, soft modems, voice recognition and low end imaging, providing both large buffer size and high processing power .



History and Development:

•ARM was developed at Acron Computers ltd of Cambridge, England between 1983 and 1985.
•RISC concept was introduced in 1980 at Stanford and Berkley.
•ARM ltd was found in 1990.
•ARM cores are licensed to partners so as to develop and fabricate new microcontrollers around same processor cores.

Key features:

1.16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
2. 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory.
128-bit wide interface/accelerator enables high-speed 60 MHz operation.
3. In- System Programming/In-Application programming (ISP/IAP) via on-chip boot loader software. Single flash sector or full chip erase in 400 ms and programming of 256 bytes in 1 ms.

Historical Background:

The invention of the transistor at Bell Telephone Laboratories in 1947 sparked a fast-growing microelectronic technology. Jack Kilby of Texas Instruments built the first integrated circuit (IC) in 1958 using germanium (Ge) devices. It consisted of one transistor, three resistors, and one capacitor. The IC was implemented on a sliver of Ge that was glued on a glass slide. Later that same year Robert Noyce of Fairchild Semiconductor announced the development of a planar double-diffused Si IC. The complete transition from the original Ge transistors with grown and alloyed junctions to silicon (Si) planar double-diffused devices took about 10 years.

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The success of Si as an electronic material was due partly to its wide availability from silicon dioxide (SiO2) (sand), resulting in potentially lower material costs relative to other semiconductors.

POWER SUPPLY:

Power supply" is sometimes restricted to those devices that convert some other form of energy into electricity (such as solar power and fuel cells and generators). A more accurate term for devices that convert one form of electric power into another form (such as transformers and linear regulators) is power converter. The most common conversion is from AC to DC.

ZigBee:

ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

•Overview

ZigBee is a low-cost, low-power, wireless mesh networking proprietary standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range.

The ZigBee Alliance, the standards body that defines ZigBee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles either published or in the works are:

•Home Automation
•ZigBee Smart Energy
•Commercial Building Automation
•Telecommunication Applications
•Personal, Home, and Hospital Care
•Toys

The relationship between IEEE 802.15.4 and ZigBee is similar to that between IEEE 802.11 and the Wi-Fi Alliance. The ZigBee 1.0 specification was ratified on 14 December 2004 and is available to members of the ZigBee Alliance. Most recently, the ZigBee 2007 specification was posted on 30 October 2007. The first ZigBee Application Profile, Home Automation, was announced 2 November 2007. ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe, 915 MHz in the USA and Australia, and 2.4 GHz in most jurisdictions worldwide. The technology is intended to be simpler and less expensive than other WPANs such as Bluetooth. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60K and 128K flash memory, such as the Jennic JN5148, the Freescale MC13213, the Ember EM250, the Texas Instruments CC2430 and the Atmel ATmega128RFA1. Radios are also available stand-alone to be used with any processor or microcontroller. Generally, the chip vendors also offer the ZigBee software stack, although independent ones are also available.

Because ZigBee can activate (go from sleep to active mode) in 15 msec or less, the latency can be very low and devices can be very responsive — particularly compared to Bluetooth wake-up delays, which are typically around three seconds. Because ZigBees can sleep most of the time, average power consumption can be very low, resulting in long battery life. The first stack release is now called ZigBee 2004. The second stack release is called ZigBee 2006, and mainly replaces the MSG/KVP structure used in 2004 with a "cluster library". The 2004 stack is now more or less obsolete.[citation needed]ZigBee 2007, now the current stack release, contains two stack profiles, stack profile 1 (simply called ZigBee), for home and light commercial use, and stack profile 2 (called ZigBee Pro). ZigBee Pro offers more features, such as multi-casting, many-to-one routing and high security with Symmetric-Key Key Exchange (SKKE), while ZigBee (stack profile 1) offers a smaller footprint in RAM and flash. Both offer full mesh networking and work with all ZigBee application profiles.

ZigBee 2007 is fully backward compatible with ZigBee 2006 devices: A ZigBee 2007 device may join and operate on a ZigBee 2006 network and vice versa. Due to differences in routing options, ZigBee Pro devices must become non-routing ZigBee End-Devices (ZEDs) on a ZigBee 2006 or ZigBee 2007 network, the same as ZigBee 2006 or ZigBee 2007 devices must become ZEDs

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on a ZigBee Pro network. The applications running on those devices work the same, regardless of the stack profile beneath them.

Uses:

ZigBee protocols are intended for use in embedded applications requiring low data rates and low power consumption. ZigBee's current focus is to define a general-purpose, inexpensive, self-organizing mesh network that can be used for industrial control, embedded sensing, medical data collection, smoke and intruder warning, building automation, home automation, etc. The resulting network will use very small amounts of power — individual devices must have a battery life of at least two years to pass ZigBee certification.

Typical application areas include

•Home Entertainment and Control — Smart lighting, advanced temperature control, safety and security, movies and music
•Home Awareness — Water sensors, power sensors, energy monitoring, smoke and fire detectors, smart appliances and access sensors
•Mobile Services — m-payment, m-monitoring and control, m-security and access control, m-healthcare and tele-assist
•Commercial Building — Energy monitoring, HVAC, lighting, access control
•Industrial Plant — Process control, asset management, environmental management, energy management, industrial device control .

Device types

There are three different types of ZigBee devices:

•ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It is able to store information about the network, including acting as the Trust Centre & repository for security keys.
•ZigBee Router (ZR): As well as running an application function, a router can act as an intermediate router, passing on data from other devices.
•ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

DC MOTOR:

In any electric motor, operation is based on simple electromagnetism. A current carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field.

As you are well aware of from playing with magnets as a kid, opposite (North and South) polarities attract, while like polarities (North and North, South and South) repel. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnet(s), and brushes. In most common DC motors (and all that Beamers will see), the external magnetic field is produced by high-strength permanent magnets1. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces.

The rotor (together with the axle and attached commutator) rotate with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The above diagram shows a common motor layout -- with the rotor inside the stator (field) magnets.

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SENSOR:

A sensor (also called detectors) is a device that measures a measurable attribute and converts it into a signal which can be read by an observer or by an instrument. for example, a mercury-in-glass thermometer converts the measured temperature into expansion and contraction of a liquid which can be read on a calibrated glass tube. a thermocouple converts temperature to an output voltage which can be read by a voltmeter.

SOIL SENSOR:

Stevens' Hydra Probe II offers a unique advantage over other soil probes by providing an all-in-one, in-situ system that can measure many different parameters simultaneously. The Hydra Probe instantly calculates soil moisture, conductivity, salinity, and temperature as well as supplying the raw voltages and complex permittivity for research applications. The data adds science to soil management for better understanding of the impact soil conditions have on plants and the climate. The objective of the Hydra Probe is to optimize analysis of soil conditions for research studies and for enhanced quality and yield of turf and crops. Hydra Probe sensing technology has been deployed for over 10 years by the USDA and is used by NASA for ground truthing of satellite based soil imaging. A compact, rugged design with potted internal components makes the Hydra Probe easier to deploy than competing sensors and ideal for remote and harsh conditions. Durable construction makes it possible for the units to remain in the field for many years, maintenance-free.

The defined sensing volume allows accurate measurements in regions where there are strong soil moisture gradients, such as near the soil surface. Response time to changing soil conditions is immediate, and calibration is as simple as selecting a soil type (sand, loam, silt or clay). Each Hydra Probe is serial addressable, allowing for multiple sensors to be connected to any RS485 or SDI-12 data logger via a single cable. Sensor data can also be sent directly to a radio modem. The Hydra Probe uses an electromagnetic signal propagated from the center tine of the probe to measure multiple parameters. The electrical properties of soil can be determined from recorded voltages, which correspond to the reflected behavior of an electromagnetic wave. On-board software converts the raw voltage to standard units of measurement for each parameter. With a standard database or spreadsheet, managers can view real-time soil snapshots or long-term soil . Measure and log current soil conditions using portable Hydra Probe sensors using Stevens HydraMon software. The user can simply spot check current conditions and save measurements to a file. When a PDA with the HydraMon software is syncronized with the computer, the file can be opened using MS Exce.

Relay:

A relay is a simple electromechanical switch made up of an electromagnet and a set of contacts. Relays are found hidden in all sorts of devices. In fact, some of the first computers ever built used relays to implement Boolean gates. In this article, we will look at how relays work and a few of their aplications.¬ A relay is used to isolate one electrical circuit from another. It allows a low current control circuit to make or break an electrically isolated high current circuit path. The basic relay consists of a coil and a set of contacts. The most common relay coil is a length of magnet wire wrapped around a metal core. When voltage is applied to the coil, current passes through the wire and creates a magnetic field. This magnetic field pulls the contacts together and holds them there until the current flow in the coil has stopped. The diagram below shows the parts of a simple relay.

LIQUID CRYSTAL DISPLAY:

LCD stands for Liquid Crystal Display. LCD is finding wide spread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons.The declining prices of LCDs.

1.The ability to display numbers, characters and graphics. This is in contrast to LEDs, which are limited to numbers and a few characters.

2.Incorporation of a refreshing controller into the LCD, thereby relieving the CPU of the task of refreshing the LCD. In contrast, the LED must be refreshed by the CPU to keep displaying the data.

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International Journal & Magazine of Engineering, Technology, Management and Research
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3.Ease of programming for characters and graphics.
4.These components are "specialized" for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

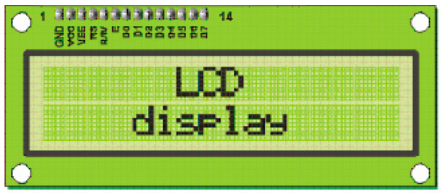

Figure 4.13 LCD

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.

keil software:

It is possible to create the source files in a text editor such as Notepad, run the Compiler on each C source file, specifying a list of controls, run the Assembler on each Assembler source file, specifying another list of controls, run either the Library Manager or Linker (again specifying a list of controls) and finally running the Object-HEX Converter to convert the Linker output file to an Intel Hex File. Once that has been completed the Hex File can be downloaded to the target hardware and debugged. Alternatively KEIL can be used to create source files; automatically compile, link and covert using options set with an easy to use user interface and finally simulate or perform debugging on the hardware with access to C variables and memory. Unless you have to use the tolls on the command line, the choice is clear. KEIL Greatly simplifies the process of creating and testing an embedded application.

Projects:

The user of KEIL centers on "projects". A project is a list of all the source files required to build a single application, all the tool options which specify exactly how to build the application, and – if required – how the application should be simulated.

A project contains enough information to take a set of source files and generate exactly the binary code required for the application. Because of the high degree of flexibility required from the tools, there are many options that can be set to configure the tools to operate in a specific manner. It would be tedious to have to set these options up every time the application is being built; therefore they are stored in a project file. Loading the project file into KEIL informs KEIL which source files are required, where they are, and how to configure the tools in the correct way. KEIL can then execute each tool with the correct options. It is also possible to create new projects in KEIL. Source files are added to the project and the tool options are set as required. The project can then be saved to preserve the settings. The project is reloaded and the simulator or debugger started, all the desired windows are opened. KEIL project files have the extension

Simulator/Debugger:

The simulator/ debugger in KEIL can perform a very detailed simulation of a micro controller along with external signals. It is possible to view the precise execution time of a single assembly instruction, or a single line of C code, all the way up to the entire application, simply by entering the crystal frequency. A window can be opened for each peripheral on the device, showing the state of the peripheral. This enables quick trouble shooting of mis-configured peripherals. Breakpoints may be set on either assembly instructions or lines of C code, and execution may be stepped through one instruction or C line at a time. The contents of all the memory areas may be viewed along with ability to find specific variables. In addition the registers may be viewed allowing a detailed view of what the microcontroller is doing at any point in time. The Keil Software 8051 development tools listed below are the programs you use to compile your C code, assemble your assembler source files, link your program together, create HEX files, and debug your target program. µVision2 for Windows™ Integrated

Development Environment:

combines Project Management, Source Code Editing, and Program Debugging in one powerful environment.

» C51 ANSI Optimizing C Cross Compiler: creates relocatable object modules from your C source code,

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» A51 Macro Assembler: creates relocatable object modules from your 8051 assembler source code,
» BL51 Linker/Locator: combines relocatable object modules created by the compiler and assembler into the final absolute object module,
» LIB51 Library Manager: combines object modules into a library, which may be used by the linker,
» OH51 Object-HEX Converter: creates Intel HEX files from absolute object modules.

What's New in µVision3?

µVision3 adds many new features to the Editor like Text Templates, Quick Function Navigation, and Syntax Coloring with brace high lighting Configuration Wizard for dialog based startup and debugger setup. µVision3 is fully compatible to µVision2 and can be used in parallel with µVision2.

Result:

The project "Automatic Irrigation And Water Pumping System Using Zigbee"been successfully designed and tested. Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced IC's and with the help of growing technology the project has been successfully implemented.

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