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Image Acquisition and Sensor based Automated Irrigation System with IOT

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***Abstract*—Irrigation in India includes a network of major and minor canals from Indian rivers, groundwater well based systems, tanks, and other rainwater harvesting projects for agricultural activities. Of these groundwater system is the largest. In 2010, only about 35% of total agricultural land in India was reliably irrigated. About 2/3rd cultivated land in India is dependent on monsoon. Irrigation in India helps improve food security, improve agricultural productivity and create rural job opportunities. Despite recent developments in irrigation control and sprinkler technology, state-of-the-art irrigation systems do nothing to compensate for areas of turf with heterogeneous water needs. In this work, we overcome the physical limitations of the traditional irrigation system with the development of a sprinkler node that can sense the local soil moisture, communicate wirelessly, and actuate its own sprinkler based on a centrally-computed schedule. A model is developed to compute moisture movement from runoff, absorption, and diffusion. In this we can reduce water consumption by 23.4% over traditional campus scheduling, and by 12.3% over state-of-theart evapotranspiration systems, while substantially improving conditions for plant health and water consumption.In this method we use the image acquisition to enhance the monitoring of the field.**

I. INTRODUCTION

. Only 1% of Earth's water is fresh and available for use and Due to its scarcity, there is high incentive to reduce its usage across the board. With a historic drought afflicating the southern Indian states following a similar shortage in the Western states of India, improved irrigation efficiency at this massive scale can help reduce the strain on our limited freshwater reserves. Although we wish to reduce water consumption as much as possible, the primary goal of these irrigation systems is to maintain plant health. To keep turf healthy, a proper amount of water must be periodically applied. Providing too little water to the turf will cause it to turn brown and die.Excess surface water can cause further waste due to evaporation and runoff and can cause root rot, killing the plant. Furthermore, over-watering can cause erosion of the surrounding soil and even leech unsafe fertilizer chemicals beyond the root zone and into the ground water table. Improper irrigation is the cause of these issues. Great improvements in irrigation system design have been made recently; new sprinkler heads apply water much more slowly to avoid runoff and leeching, and new irrigation controllers schedule irrigation using weather data to take into account the water lost each day due to evaporation and plant transpiration, known coupled as evapotranspiration. Even the best control strategies still behave as though all turf requires the same amount of water, when in fact there often exist large variations in soil type and depth, topography, and direct sunlight. If this information were utilized, every location throughout the irrigated space could be given the amount of water it needs. However, as the infrastructure of traditional irrigation systems is usually configured for each valve to actuate many sprinklers. Our contributions addresses both of these limitations. First, we develop a computationally-light model that uses characteristics of the irrigated space to analyze the fundamental causes of fluid movement. This model is then integrated into an optimization framework to allow for optimal valve scheduling to be computed. The second contribution is the development of the Automated irrigation sprinkler node, capable of actuating its attached sprinkler, sensing local soil moisture, and communicating wirelessly with its sister nodes in the environment. In this automated irrigation technique we use the image acquisition to monitor the field offline and to prevent the venturing of animals, the statistical record of the field will be retained in the cloud for ease of access and measurements of each sensors can be monitored pricesly.

II. WORKING PRINCIPLE

To attain our proposed system need to use PIC16F877A, controller to monitor the field using sensors such as temperature, humidity, water level and soil nutrition. The PIR sensor is used to identify the animals enter into the field. Nutrition sensor used to identify the nutrition level in the soil. Temperature and humidity sensor used to measure the temperature and humidity level in the field respectively. The

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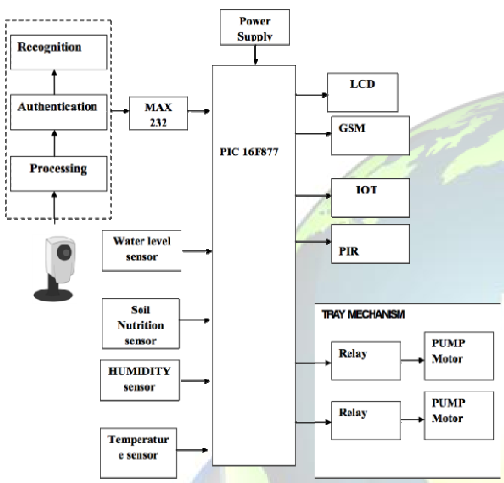
animals and birds enter into the field is identify through camera using image processing technology. If any abnormalities means send SMS to the owner. All the data's uploaded to the cloud using IOT module. PIC 16F877A Controller status and everything is displayed in LCD.

III. BLOCK DIAGRAM



IV. EXPLANATION

1. MICROCONTROLLER - PIC 16F877A&USART

Operating speed: 20 MHz, 200 ns instruction cycle
Operating voltage: 4.0-5.5V
Industrial temperature range (-40° to +85°C)
15InterruptSources, 35 single-word instructions
Programmable code protection, power saving sleep mode.

In this tutorial we will study the communication component – USART (Universal Synchronous Asynchronous Receiver Transmitter) located within the PIC. It is a universal communication, component (Synchronous/Asynchronous), this can be used as transmitter or as receiver. We will look at

serial and parallel communications

synchronous and asynchronous communications

how to enable serial communication - TXSTA and RCSTA registers

An example of 8-bit transmission

An example of 9-bit transmission

how to calculate the value being placed in the SPBRG register

USART Transmit and Receive block diagrams

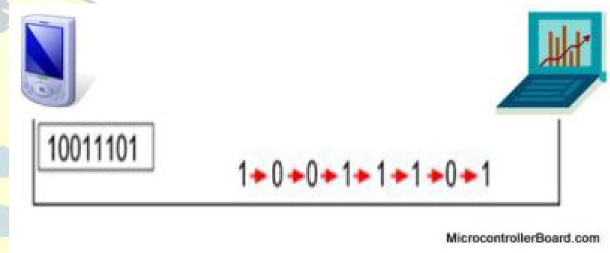
Max323 Driver/Receiver, the implementation of the PIC serial communication (C program and a video)

Serial Communication

Parallel Communication

i. SERIAL COMMUNICATION

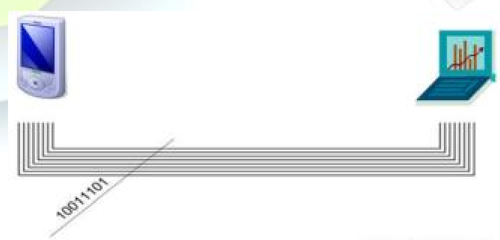
When using the serial communication we transmit the multi-bit word bit after bit (when at any given moment only one bit will pass).



Transmitting the word 10011101 using serial communication.

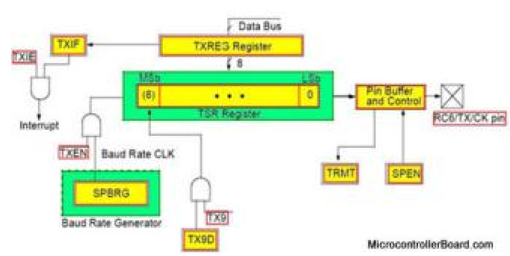
ii. PARALLEL COOMUNICATION

When using the parallel communication, however, the number of bits will be transmitted at once from one computer to the second computer.



Transmitting the word 10011101 using parallel communication.

a. USART TRANSMITTER



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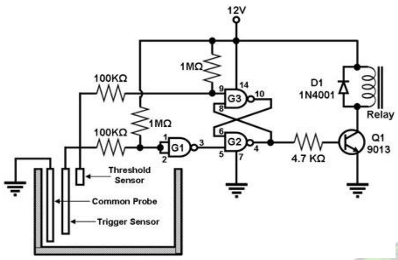
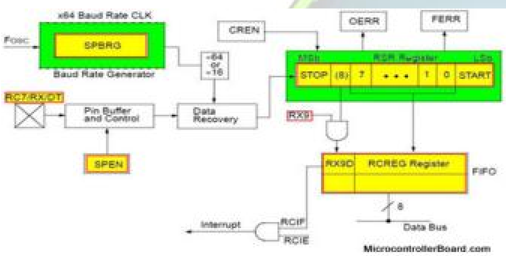
If you want to transmit a 9-bit data, the 9th bit is loaded into TX9D. At the same time, the information above is being loaded into the register TSR, which is used as a temporary buffer before that information is transmitted.



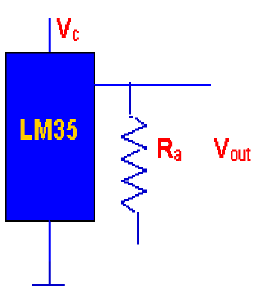
b. USART RECEIVER



The information is received in the register RSR. If there is a 9-bit transmission, the 9th bit goes into RX9D. After receiving the data in the register RSR, the information is loaded at the same time into the register RCREG. Obviously, using 2 registers allows faster receiving of the data. While the information that was received being transferred into RCREG, the new information has already been received into the register RSR. Of course, the CREN bit needs to be set. According to the USART TRANSMIT / RECEIVE BLOCK DIAGRAM, that the information that was transmitted via pin RC6 in Port C, is received through the pin RC7 in Port C.

2. *TEMPERATURE SENSOR - LM35*

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C) , If the temperature exceeds above 50 °C the pump motor will turn ON, as according to the instructions.

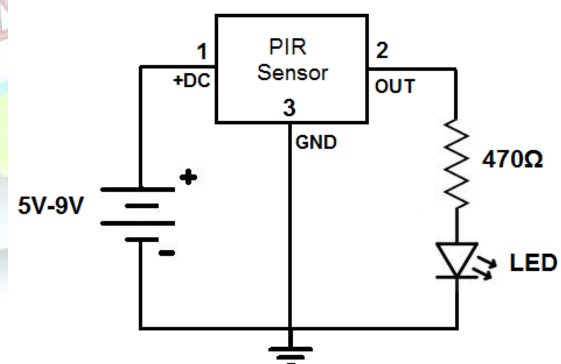


3. *WATER LEVEL SENSOR*

The probe is formed by two electrodes one will be core another will be the shield. When the probe is inserted in the liquid or powder the capacitance varies proportionally this increase in capacitance results in increased amplitude of oscillation. The amplitude of oscillation is measured an evaluator circuit to get analogue output proportionally to the level and a switching output.

4. *PASSIVE INFRA-RED SENSOR*

A **Passive Infrared sensor (PIR sensor)** is an electronic device that measures infrared (IR) light radiating from objects in its field of view. Apparent motion is detected when an infrared source with one temperature, such as a human, animals passes in front of an infrared source with another temperature can be detected. If the animals comes into the line of sight to the sensor the buzzer at the field gets activated. In order scare the animals venturing into the field. Pyroelectric devices, such as the PIR sensor, have elements made of a crystalline material that generates an electric charge when exposed to infrared radiation. The changes in the amount of infrared striking the element change the voltages generated, which are measured by an on-board amplifier. The device contains a special filter called a Fresnel lens, which focuses the infrared signals onto the element. As the ambient infrared signals change rapidly, the on-board amplifier trips the output to indicate motion.



5. *HUMIDITY SENSOR-DHT11*

This DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This

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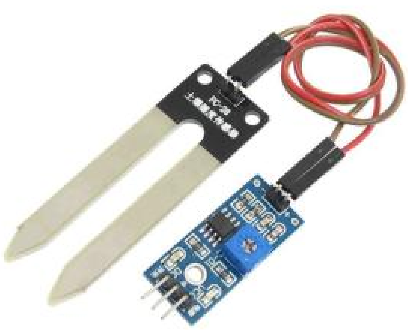
sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The single-wire serial interface makes system integration quick and easy.

6. SOIL NUTRITION SENSOR

Soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. It measures the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, or electric conductivity.



7. DC MOTOR

i. This DC or **direct current motor** works on the principal, when a current carrying conductor is placed in a magnetic field, it experiences a torque and has a tendency to move. This is known as motoring action. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of **DC motor** is established.

ii. The direction of rotation of a this motor is given by Fleming's left hand rule, which states that if the index finger, middle finger and thumb of your left hand are extended mutually perpendicular to each other and if the index finger represents the direction of magnetic field, middle finger indicates the direction of current, then the thumb represents the direction in which force is experienced by the shaft of the **DC motor.**

8. CAMERA

CCTV stands for Closed Circuit TV. CCTV uses one or more video cameras to transmit video images and sometimes audio images to a monitor, set of monitors or video recorder.

Most wireless CCTV cameras use the 2.4 Gigahertz frequencies to transmit their video images to a monitor or DVR (digital video recorder).

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9. INTERNET OF THINGS

Internet of Things (IoT) is an environment in which objects, animals or people are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IoT board featured with SIM900 GPRS modem to activate internet connection also equipped with a controller to process all input UART data to GPRS based online data. Data may be updated to a specific site or a social network by which the user can able to access the data.

The **internet of things** (**IoT**) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society. The IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems,

10. EMBEDDED C

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality issues that exist between C extensions for different embedded systems. Historically, embedded C programming requires nonstandard extensions to the C language in order to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations.

In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as, fixed-point arithmetic, named address spaces, and basic I/O hardware addressing.

Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, datatype declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc.

a) MATLAB

MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and fourth-generation programming language. A proprietary programming language developed by Math Works, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in including C, C++, Java, Fortran and Python.

b) MPLAB IDE

Microchip has a large suite of software and hardware development tools integrated within one software package called MPLAB Integrated Development Environment (IDE). MPLAB IDE is a free, integrated toolset for the development of embedded applications on Microchip's PIC and dsPIC microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows, is easy to use and includes a host of free software components for fast application development and supercharged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools.

c) COMPONENTS OF MPLAB

The MPLAB IDE has both built-in components and plug-in modules to configure the system for a variety of software and hardware tools.

a) **Project Manager:** The project manager provides integration and communication between the IDE and the language tools.

b) **Editor:** The editor is a full-featured programmer's text editor that also serves as a window into the debugger.

c) **Assembler/Linker and Language Tools:** The assembler can be used stand-alone to assemble a single file, or can be used with the linker to build a project from separate source files, libraries and recompiled objects. The linker is responsible for positioning the compiled code into memory areas of the target microcontroller.

d) **Debugger:** The Microchip debugger allows breakpoints, single stepping, watch windows and all the features of a modern debugger for the MPLAB IDE. It works in conjunction with the editor to reference information from the target being debugged back to the source code.

e) **Execution Engines:** There are software simulators in MPLAB IDE for all PICmicro MCU and dsPIC DSC devices. These simulators use the PC to simulate the instructions and some peripheral functions of the PICmicro MCU and dsPIC DSC devices. Optional in-circuit emulators and in-circuit debuggers are also available to test code as it runs in the applications hardware.

V. CONCLUSION

Fresh water is a delicate resource, and we must find ways to use it sustainably.In this system can reduce system water consumption by 23.4% over our campus' control strategy, and by 12.3% over a state-of the-art evapotranspiration system.This system can help provide more precise irrigation to turf areas, reducing water usage and substantially improving the quality of strategies to conserve water and to make irrigation automation as described by the circuits.As the system of irrigation is based on automation it will help farmers to properly irrigate their field.Farmers can have ease of access over GPS and can retain their stored in cloud using IOT,when they are away from the field.Another added advantage of this irrigation system is that the camera can caputre the images of the animals and humans who venture into the field. To overcome the necessity of manual work and ease the irrigation system for our farmers the proposed model of automated irrigation can be alternative.

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