Automated Drip Irrigation System Using Intel Galileo

Silpa V M
Student Member of ACM,
Department of Computer Science and Engineering,
Vidya Academy of Science And Technology, India.

Geethu P C
Assistant Professor,
Department of Computer Science and Engineering,
Vidya Academy of Science and Technology, India.

Aswathi S
Student Member of ACM,
Department of Computer Science and Engineering,
Vidya Academy of Science And Technology, India

Aswini S Prasad
Student Member of ACM,
Department of Computer Science and Engineering,
Vidya Academy of Science And Technology, India

Abstract

We know that agriculture is the main sector which provides a major contribution to our Indian economy. The   main two challenges faced by this area are   water scarcity and labour shortages. Since we are facing the problem of scarcity of water, not only water conservation is needed, but it is also important to use proper method of irrigation to reduce the water wastage. We know that drip irrigation is an efficient method which is both easy and economical one. It helps for proper watering of plants. Since IoT is an emerging technology, it can be applied in several agricultural areas like monitoring quality of water and constituency of soil, water irrigation, crop diseases and monitoring pests etc. Here we are proposing an automated drip irrigation system using Intel Galileo which make use the advantages of IoT. This system helps to reduce the wastage of water on irrigation and removes the need for workmanship. This system is a low-cost and energy efficient system. It can be used not only in big agriculture fields but in small gardens also via sending an email to the system to water plants. Here the input will be an email which is sent to run the system for X minutes, which kept as the subject line of the mail. After X minutes, the pump will automatically turn off. By using this system, we can control the relay board and through that the motor also can be controlled remotely It will help to control the water flow as well as the electrical flow. Here, our aim is to introduce a smart and efficient remotely accessible drip irrigation method to as a solution to the water wastage problems. This system helps to save manpower, water and the time, since irrigation is a time consuming activity .It also improves the production and provides a new face to the irrigation systems.

Keywords: Intel Galileo Board, Arduino, Automated Drip Irrigation System

INTRODUCTION

Agriculture is one of the broadest sector which plays strategic role in overall Indian economy. It contributes about sixteen percent (16 %) of total GDP and ten percent (10%) of total exports. India is one of largest country in farm output on worldwide ranking. So agriculture needs special attention and it has to be modernized for better productivity. Nowadays, Indian agriculture is facing a lot of problems like fragmented land holding, gamble of monsoon, threats of global warming, soil erosion, and improper irrigation mechanisms and lack of non-renewable groundwater. Recent surveys says that on worldwide, 85% of available freshwater resources is used in agricultural sector. Due to the population growth, the demand of food also will be incerased. Thus, this percentage will continue to be dominant in water consumption. There is an urgent need to create strategies to resolve the problems in water shortage and modernize the agriculture area with the help of emerging technologies.

We know that as a part of the agriculture modernization, the irrigation systems are getting automated with the help of different smart equipments and devices. It helps to make an efficient use of the electricity and water and thus reduces much of the wastage. It is well known that irrigation by drip is very economical, simple and efficient. The conventional drip irrigation system is fully controlled and monitored by the farmer. The objective of this work is to develop a smart drip irrigation system which automates and regulates the watering with minimal manual intervention.

This paper presents a smart drip irrigation system with the use of devices like Intel Galileo board, Arduino microcontrollers. And Python is used for programming the automation part. This paper contributes an efficient remotely accessible irrigation system which is suitable for common man since it's a fairly cheap one. The system has no maintenance cost once it get installed and it is easy to use.

INTEL GALILEO BOARD– AN OVERVIEW

The Intel Galileo board is the first Arduino board based on Intel architecture (Intel Quark SoC X1000), which is basically a developer board designed to have powerful functionalities with minimum power consumption.

The block diagram of Intel Galelio board is given in Fig 1. There are mainly two levels - legacy controlled blocks and through advanced microbuses .The legacy controlled blocks are mainly dedicated for definite set of functions .It's through

allocation of dedicated channels for each. This board runs at 400MHz. The real time clocke, integrated with the board, helps to synchronize the data between modules.

The Galileo board has dedicated point to point connection in PCIe. This mini PCI express(PCIe) helps to connect standard mPCIe modules like Wi-Fi, Bluetooth, and SIM card adapters for cell phones. AMB helps to have high speed connectivity in respect to CPU and peripherals. And it is basically divided into two part – system bus and peripheral bus connecting each other through bridge.
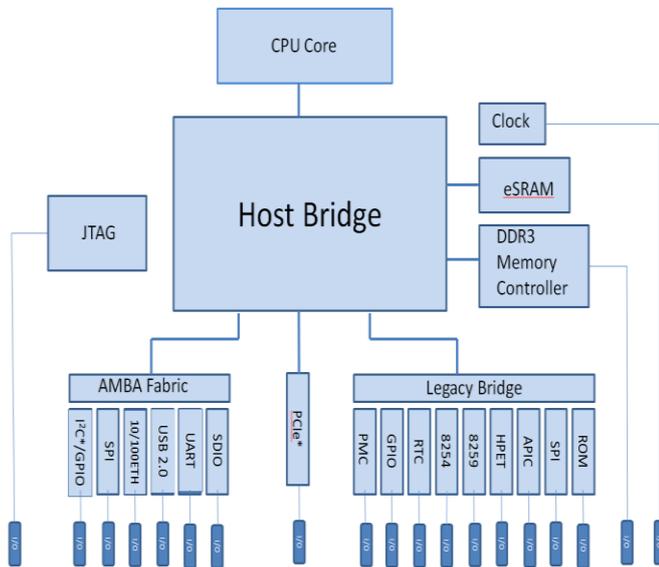

Figure 1. Block diagram of Intel Galileo Board

Other parts of Intel Galileo board are:

- DDR3 : Known as Double Data Rate type 3 synchronous dynamic random access memory with high bandwidth interface.

- SPI : Serial Peripheral Interface bus.Helps for synchronous communication in duplex mode in a master-slave scenario.

- UART : Universal Asynchronous Receiver/Transmitter.A hardware which helps to translates data between parallel and serial forms

- GPIO : General Purpose I/O controlled by user runtime

- 8254 : Known as Program Interval Timers. The

main function is performing timing and counting function

- 8259 : Programmable Interrupt Controller. Helps to combine multiple interrupt sources into single interrupt output to host processor

- SRAM : Static RAM. But in Galileo, it act as cache memory

- JTAG : 10 pin standard JTAG header for debugging

- I^2C : Inter-Integrated Circuit, a bus which is used for attaching low speed peripherals to computer mother boards and embedded systems. It also collects data from sensors and other devices

METHODOLOGY

A. System Architecture

The system architecture is comprised of components like sensors and Intel Galileo board. To start the system, send an email to a predefined account with subject line "Pump On" and the no. of minutes to water as its content. The Intel Galileo will poll for emails in this email account. Google email account is used here. When the mail recieved, first the system will check the subject line, if it's the predefined one ,then abstracts the no. of minutes to be watered and then switch on the relay for watering plant. There will be threshold values, both maximum and minimum, are set as per the water level in the tank. If the water level falls below a threshold level(minimum), a signal will send to microcontroller to trigger the motor to refill the tank. At that time ,the watering will get stopped. After refilling the tank ie. when reaching the maximum threshold, it again switch on the motor for watering the plant. And the refilling pump het switched off automatically. The water level in tank does not fall below or go above a threshold with the help of ultrasound distance sensor.

DESIGN AND IMPLEMENTATION

The system design is given in Figure 2 and Figure 3 shows the flow diagram of the proposed system .The main components of the system is described in detail as follows ,along with the functionality of each block.
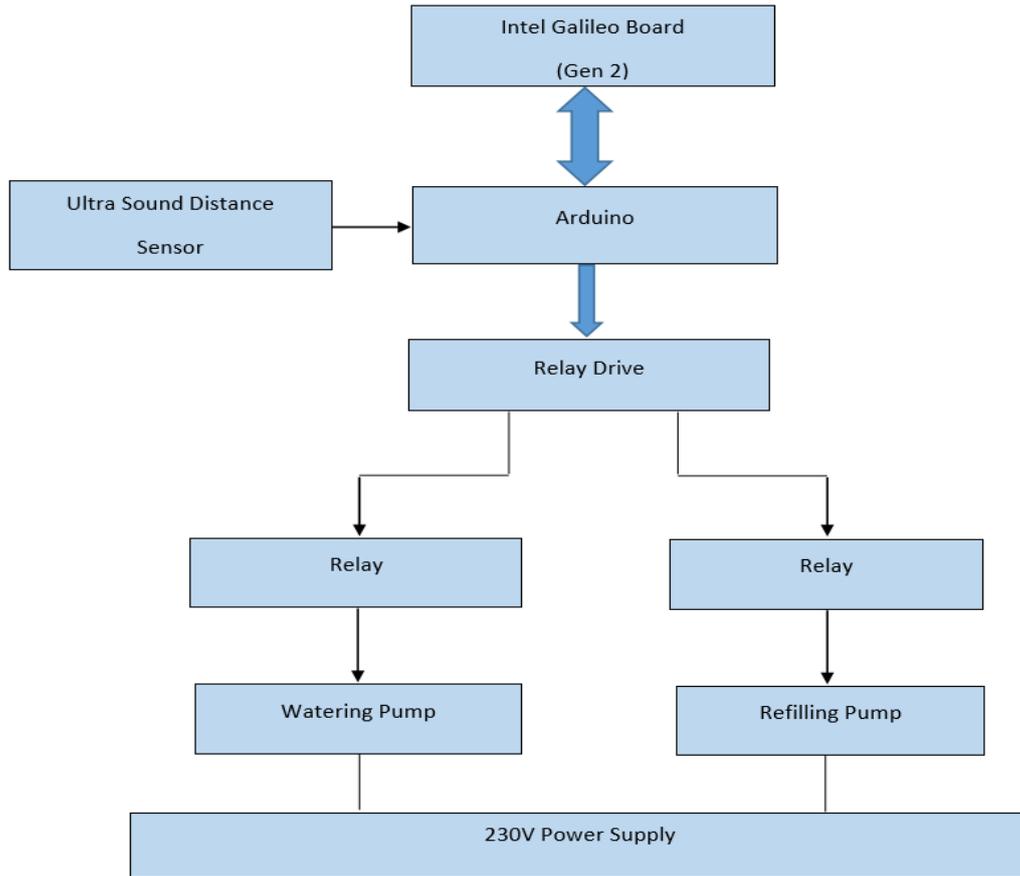
Figure 2. Design of the Proposed System

A. Send Email

To start the system, an email is sent to a defined account having subject line : "Pump On" and which contains the no. of minutes to water the plants.

B. Email Account

Intel Galileo will poll for emails in this email account. Google email account is used here.

C. Intel Galileo Board

Generation 2 of Intel Galileo is used in here. When the email is received, one of the GPIO is turned high. A program written in Python has been used to receive email and sets the GPIO pin high for the requested duration. The same program is used to send the status updates to user's email . SMTP library and IMAP library are the libraries used here to send status email and for email polling. .

D. Arduino

It is a micrcontroller which is used to control relay and ultrasound distance sensor..In case a low water level is detected by the sensor then a signal will be sent from the microcontroller to Intel Galileo. Intel Galileo will replay the same signal to arduino and pump to refill the tank will be turned on via relay .

E. Relay Board

There are several pins like IN1,IN2,IN3 and IN4 which are the input pins (IN2 and IN3 are used here) The input pin IN2receives logic high and in turn switches on the relay, RE1,RE2,RE3 and RE4 are the pins for 12V relays. The "VCC" and GND pin of the relay are connected to 5V supply and ground respectively.

F. Power Supply

The device to be switched, here, is an electrical water pump which runs on 240V supply.

G. Ultra Sound Distance
   Sensor

This sensor is used to measure the water level in the tank. It will not let the water level in tank does not fall below or go above a threshold. Thus it helps to avoid any damage in the water pump.

Figure 3. Flow Diagram of the proposed System

RESULTS

The connection diagram of Intel Galileo and the relay is shown in Figure 4 (a) and it's working is shown in Figure 4 (b).
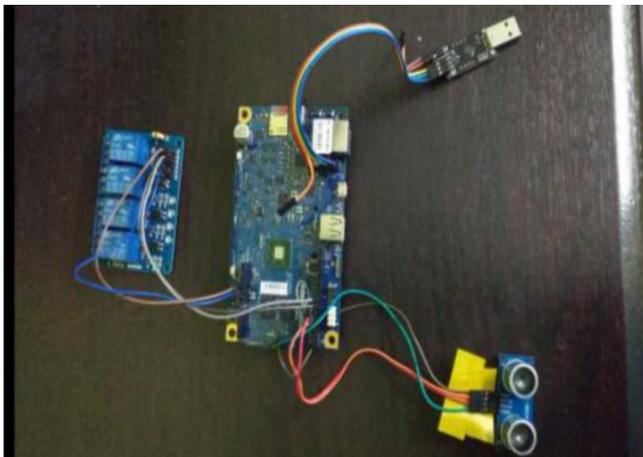

Figure 4 (a). Connection Diagram of Intel Galileo Relay
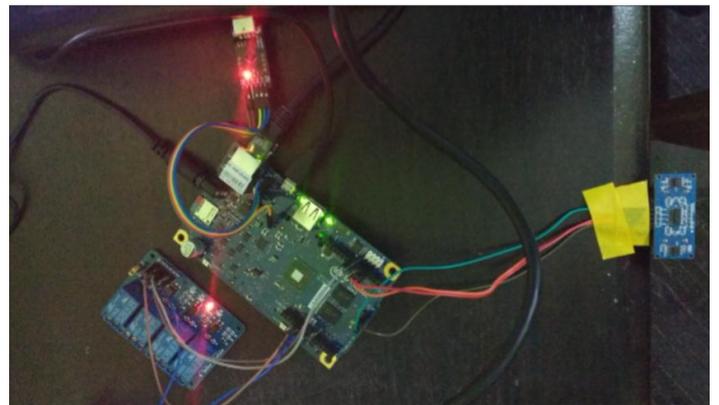

Figure 4 (b). Working of Intel Galileo and the relay

The system get installed in a small scale set up, a small terrace garden. To check the reliability of the proposed system ,the experiment kept run once a day till one month. It is found that the system works properly and the water is passed to the plants as and when required. The screenshots of the working of the system is given below (fig 5 (a) and fig 5 (b)) :
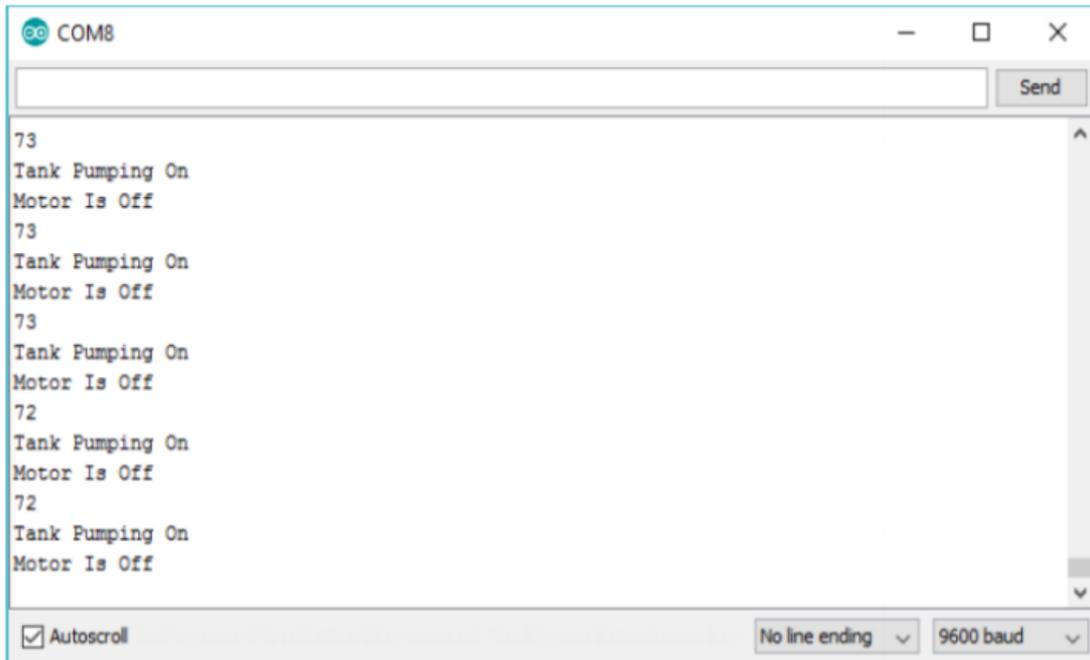
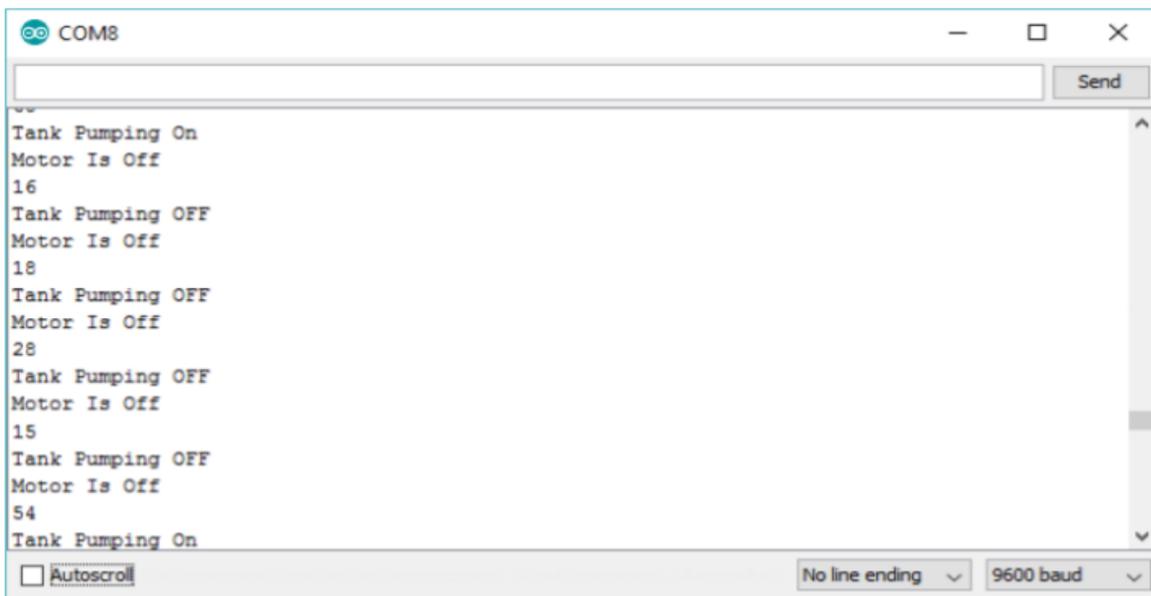**Figure 5 (a).** Level of Water greater than threashold(Minimum)

Figure 5 (b). Level of water less than threashold(Maximum)

CONCLUSIONS

This Smart drip irrigation system is helpful for not only the farmers with large lands but also the gardeners ,with small area like terrace and who do not have enough time to water crops or plants. The test results proves that this highly useful for young farmers who are also doing another office jobs as it automates and regulates the watering with minimal manual intervention .Here sending the emails to the system can be automated but manual sending of the emails has control over the system regarding whether or not to run the system depending upon the weather conditions. Using this system, pumps and relay board can be controlled remotely through a simple mail .It opens the opportunities to control the water flow as well as the electrical flow.

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