**S.A.R.I.B.O.**

***(Systematic and Automated Regulation of Irrigation systems for***

***Backyard farming Operations)***

An Arduino-based Internet-of-Things Irrigation System designed for Backyard Farming

Submitted to:

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March 3, 2020

**Overview**

The advancement of technology today is inevitably and regularly updating. New technologies such as home and farm automation that uses wireless connections prove that every day, innovation is possible. The management and processes of people specifically farmers and gardener’s day to day life, like monitoring and managing of gardens or farms can be improved through the use of innovation and of the present technologies.

Technology is indeed becoming more advanced as the day passes, and the proponents established the idea that the processes performed in gardens and farms can be automated. Existing garden and farm processes heavily rely in traditional methods which is requiring too much effort and time. This includes processes such as fetching water, storing and refilling of water to the water tank, watering the plants, and farmers, and even gardeners needs to constantly go to their farms or gardens to check for the dryness of the soil. These issues are the main reasons why the researchers conducted this study.

Through this study, the proponents will develop and implement an automation system to eliminate or reduce the time and effort exercised to carry out these processes. This will address the issue of fetching, and storing of water, refilling of water tank, and watering the plants. Through this study, a water tank is used wherein the refill, drain and checking the water level in the tank uses electrical devices that reduces and eliminates the amount of work done and checking the level of soil moisture could be processed in real time without the user to go to the farm or garden. This will employ sensors and microcontroller unit that gathers and processes data from the field, the use of higher voltage devices such as relays for the control of pump and valves, and other devices and sensors that gathers, store and send data such as SD Card modules among others.

The system will be named “***SARIBO***”, a waray-waray term for “to water” such as to water plants. ***SARIBO*** stands for ***Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations,*** is an IOT (internet-of-things) enabled project using Arduino and NodeMCU ESP8266 that is designed for the automation of irrigation processes of backyard farming.SARIBO has two separate modules – the ***Root*** module which controls the main controller functionalities such as tank refill, drain and distribution, opening of valves for specific plots (distribution lines), the overall management of the Wi-Fi network, central data repository, SMS notification, date and time functionalities, among other major system functions, and the ***Leaf*** module that manages the processes present in the plots (distribution lines) such as checking the soil moisture level, sending data request to the Root module, and other functionalities.

The proponents believe that the system that will be developed and implemented will solve the stated problems. Through the use of the system, its users

would have convenience in monitoring and controlling electrical power switch at

home.

**Organizational Description**

**Background**

Thereis a quote that is very accurate in describing a farmer, according to Wendel Berry “Farmers farm for the love of farming. They love to watch and nurture the growth of plants. They love to live in the presence of animals. They love to work outdoors. They love the weather, maybe even when it is making them miserable”. Every farmers mind set is to produce a healthy crops or animals in order to feed people for a living. They are so much into taking care of their plants and producing the best of it not just in order to give themselves food for living but also to gain money to survive in this world, no matter how bad or good the weather is all of the farmers instinct is to have a great harvest.

**Mission**

To collectively empower farmers and fisher folk and the private sector to increase agricultural productivity and profitability, taking into account sustainability and resilience.

**Vision**

A food secure Philippines with prosperous farmers and fisher folk.

**Business Process**

**Problem Statement**

According to the House Bill No. 1718, agriculture is the traditional backbone of Philippine economy and the principal source of employment, employing almost half of the total labor force. It has been considered as a major industry source of the Philippines due to the fact that we are an agricultural country which in fact, our country relies heavily in agriculture. However, farmers were observed to use the traditional way of farming instead of adapting new agricultural technologies, which made the agribusiness farms productive and profitable.

Farmers can use the inventions of agricultural technology in order for it to maintain the growth of its crops and even in maintaining the supply of the water whenever there are weather interruptions or any other occurrence might come along.

After identifying the problems, opportunities, objectives, and constraints throughout the making of the study, a matrix has been made.

**Objective**

The proponents aim to develop and implement an Internet-of-Things (IOT) Automated Plant Watering System for farmers, gardeners, hobbyists, plant collectors, or even individuals who owned a backyard farm or garden and have the following objectives:

1. eliminate or reduce the throughput or the amount of work being performed in fetching water;
2. eliminate or reduce the throughput or the amount of work being performed in storing water;
3. eliminate or reduce the throughput or the amount of work being performed in watering the plants; and to
4. eliminate or reduce the throughput or the amount of work being performed in measuring or detecting the dryness of the soil.

**Scope and Limitation**

The system is designed for the development of A Proposed Internet-of-Things (IOT) Automated Plant Watering System for farmers, gardeners, hobbyists, plant collectors, or individuals who owned a backyard farm. The following queries are the scopes and the limitations of the proposed system are as follows:

**Scope:**

1. **Able to detect soil moisture.**

The system is capable of detecting the moisture of the soil, it is the way of monitoring used whether the plants need to be watered or not.

1. **Fully automated plant watering.**

The system is designed to automatically water the plants in terms of the moisture of the soil, and if it's detected that the plant is in need of watering then the system leaf will be communicated to the root and request for a water.

1. **Fully automated water tank refill.**

The system well automatically refill tank before distributing water to the leaf or the system will distribute water first and then refill, It is the two sittings which is: Refill first before discharge and discharge first then refill.

1. **Provides detailed and accurate system activity logs.**

The system will automatically record everything that the system does.

1. **Equipped with a SMS notification.**

The system is designed with an SMS notification. It is capable of notifying the user whether an interruption occurred on the functionality of the systems either a malfunction happened or any other occurrence.

1. **Running on Wi-Fi with a range of 250 meters.**

The system is applicable on the field ranging about 250 meters.

1. **Fully customizable settings.**

The system is designed depending on what the users wants to from the overall setting of the system. Also, its either time based or according to the moisture of the soil. Then the setup of the apparatus depends also on the user when being implemented on the field.

1. **Deep sleep mode functionality.**

The Leaf is capable of hibernating, whenever it is night time or whenever there is no need to water plants the systems leaf will automatically hibernate itself.

**Limitations:**

1. **Electrically powered main controller.**

The main controller stops or it will not function whenever the electrical power is not available because the main controller is dependent to the electricity.

1. **Poor-to-No network coverage in the area.**

The SMS notification cannot be able to notify the user if there were no network connections.

1. **Provides detailed and accurate system activity logs.**

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**REQUIREMENTS**

**Business Requirements Overview**

Farmers, gardeners, hobbyists, plant collectors, or individuals who owned a backyard farm have been using the traditional way of farming. The traditional way of farming is considered to be exhausting in a sense that farmer need to take care of their plants in all way possible. It should be monitored by the farmers itself. And they had to be there in the process of growing, in terms of fetching water in order to water the plants, especially during dry seasons. So, because of that the farmers would not be able to do any other tasks they need to do in a daily basis it is because of the fact that they had to focus on checking out with there plants. Farming well take the time they can spent to other things and it would take their strength as well, and efforts well be exerted only on one task specifically monitoring there farm each day.

After knowing all those weary tasks of farming, the researchers come to a realization of proposing an Internet-of-Things (IOT) Automated Plant Watering System in response to the hardship of the farmers. This has been proposed in order to give ease in every farmers life.

**Functional Requirement Specification of S.A.R.I.B.O. *(Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations):***

|  |  |
| --- | --- |
| **Functionalities** | **Description** |
| Work Breakdown Structure |  |
| Prototypes |  |
| Models and Diagram |  |
|  |  |
|  |  |
|  |  |

**Non-Functional Requirement Specification of the** **S.A.R.I.B.O. *(Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations):***

|  |  |
| --- | --- |
| **Non-Functionalities** | **Description** |
| Security |  |
| Capacity |  |
| Performance |  |
| Reliability |  |
| Timely |  |
| Availability |  |

**SYSTEM REQUIREMENTS**

**Hardware Requirements Specification of** **S.A.R.I.B.O. *(Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations):***

|  |  |  |
| --- | --- | --- |
| **Hardware** | **Specification** | **Description** |
| Microcontroller Unit | Arduino Nano ATmega328P CH340G | The micro controller unit (MCU) responsible in the processing, management, control of the overall functionality of the system. |
| Wi-Fi Microcontroller Unit | NodeMCU V3 ESP8266 ESP-12E | The micro controller unit (MCU) responsible in the establishment, control, management, of the Wi-Fi communication functionality of the system. |
| Computer Set | ASUSTeK X540UP  Intel(R) Core(TM) i7-7500U CPU @ 2.70GHz (4 CPUs), ~2.9GHz  4096MB RAM  64-bit operating system | The computer system used during the design and development of the system. |
| Water Valve | 12Volts DC Plastic Solenoid Water Valve (Normally Closed) ½” | The type of water valve used in controlling the water flow. |
| Water Flow Sensor | Plastic Water Flow Sensor ½” | The water flow sensor used in determining the rate of water flow in the pipes. |
| MicroSD Card Module | MicroSD Card Adapter for Arduino | Used for data logging functionalities. |
| Real Time Clock | DS3231 RTC Real Time Clock and EEPROM AT24C32 Module | Used for date and time functionalities. |
| Ultrasonic Ranging Sensor | HC-SR04 Ultrasonic Ranging Sensor | Used in determining the water level in the tank/reservoir. |
| Soil Moisture Sensor | Soil Moisture Sensor Module for Arduino | Used in determining the soil moisture level. |
| Custom made Pump | 12V/24V DC 775 Motor Double Ball Bearing | The custom pump used the 775 Motor. |
| Drip Irrigation Pipes | Drip/Atomizer Irrigation System Pipes | Pipes used in controlling the water output that is being supplied to the plants. |
| Distribution Pipes | ½” Blue PVC Pipe | Pipes used in the pump and distribution lines. |
| Relay | 4-Channel 5V Low Level Trigger 10A 250 VAC Relay with Optocoupler JQF-3FF-S-Z | Relays used in controlling the pump and other higher voltage devices. |
| DC to DC Converter | DC to DC Voltage Regulator Step Down Buck Converter Power Supply Module 9V/12V/24V/36V DC to 5V DC | Converts the 12V DC power that is supplied to the pump and other higher voltage devices to 5V DC which powers the microcontroller units and other sensors. |
| Power Supply | 12 Volts DC 3amp Power supply charger | Provides the power for the system. |

**Software Requirements Specification of S.A.R.I.B.O. *(Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations):***

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| --- | --- | --- |
| **Software** | **Specification** | **Description** |
| Operating System | Windows 10 Home Single Language 64-bit (10.0, Build 18362) (18362.19h1\_release.190318-1202) | The operating system used during the development and design. |
| Integrated Development Environment (IDE) | Arduino IDE Version 1.8.10 | The Integrated Development Environment (IDE) of the Arduino wherein codes during the development are written. |
| CH340G Device Driver | Arduino Nano ATmega328P CH340G Device Driver | Enables the ability for the Arduino Nano to communicate with the computer's operating system and the Arduino IDE. |
| ESP8266 Board Device Driver | NodeMCU 12E version 3.0 ESP8266 Board Device Driver for Arduino | Enables the ability for the NodeMCU ESP8266 Board to communicate with the computer's operating system and the Arduino IDE. |
| ArduinoJSON Library for Arduino | ArduinoJSON Library Version 6.14.1 by Benoit Blanchon | An Arduino library used as the parser/decoder of data of the system that will be sent via the Wi-Fi communication of the modules of the system. |
| SD Library for Arduino | SD Card Library Version 1.2.4 by Arduino.cc and SparkFun | An Arduino library used for the data logging purposes. |
| Software Serial Communication Library for Arduino | Software Serial Communication Library for Arduino (SoftwareSerial.h) that is included in the Arduino Core libraries | Provides the functionality for the software serial communication between the Arduino Nano and the ESP8288 NodeMCU Wi-Fi Module. |
| Real Time Clock Library for Arduino | Real Time Clock Library for Arduino (RTClib.h)  Version 1.3.3 by AdaFruit | Provides the functionality for the setting and accessing of date and time. |
| HCSR04 Ultrasonic Ranging Sensor Library for Arduino | HCSR04 Ultrasonic Ranging Sensor Library for Arduino (HCSR04.h) Version 2.0.2 by gamegine | Provides the functionality for the control and use of the HCSR04 Ultrasonic Ranging Sensor Module used in determining the water level in the tank. |
| Wi-Fi Library for ESP8266 NodeMCU | ESP8266 NodeMCU Wi-Fi Library (ESP8266WiFi.h)  Copyright (c) 2011-2014 Arduino. Modified by Ivan Grokhotkov, December 2014  Provided in the esp8266 NodeMCU board. | This provides the functionality in configuring the network settings such as setting the network SSID, the SSID password, ports to be used, IP address, the subnet and other communication related settings. |
| Web Server Library for ESP8266 NodeMCU | ESP8266 NodeMCU Web Server Library (ESP8266WebServer.h)  Copyright (c) 2014 Ivan Grokhotkov  Provided in the esp8266 NodeMCU board. | This provides the network router or the web server that serves as the address or the routes wherein date could be sent or retrieved. |

**Human-Resource Requirements of S.A.R.I.B.O. *(Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations):***

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| --- | --- |
| **Peopleware** | **Role** |
| **Users** | The users serve as the beneficiary of the system. They will be the end users who will be using the system. |
| **System’s Analyst** | The person in charge in the assessment and suitability of the intended outcomes or the objectives of the system and the communication with the end users.  Systems analysts also serve as a researcher and agent who identify the organizational improvements needed, design systems to implement those changes, and train and motivate others to use the systems.  The System Analyst together with the System Database Designer prepares the system documentation. |
| **System’s Programmer** | The person who writes program code logic and translate requirements into program. The System’s Programmer has duties that include the managing of the system’s performance, providing technical support, reviewing and updating existing programs and the modification of source codes, and identifying and fixing defects in the system.  In this system, the System’s Programmer also serve as the Project manager and in addition to his tasks, he also manages the project and the team and give specific task to its project members. |
| **System’s Database Designer** | The person who is responsible for defining the detailed database design, system documentations and together with the System’s Analyst serve as a researcher and agent who identify the organizational improvements needed, design systems to implement those changes, and train and motivate others to use the systems. |

**Budgetary Requirements of S.A.R.I.B.O. *(Systematic and Automated Regulation of Irrigation systems for Backyard farming Operations):***

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| --- | --- |
| **Item** | **Amount** |
| Arduino Nano ATmega328P CH340G Soldered (2 pieces) | Php. 450.00 – (Php. 225.00 per piece) |
| NodeMCU V3 ESP8266 ESP-12E (2 pieces) | Php. 320.00 – (Php. 160.00 per piece) |
| 12VDC Plastic Solenoid Water Valve (Normally Closed) 1/2" (5 pieces) | Php. 1,495.00 – (Php. 299.00 per piece) |
| MicroSD Card Reader Module (2 pieces) | Php. 158.00 – (Php. 79.00 per piece) |
| DC to DC Voltage Regulator Step Down Buck Converter Power Supply Module 9V/12V/24V/36V DC to 5V DC (1 piece) | Php. 70.00 |
| 4-Channel 5V Low Level Trigger 10A 250 VAC Relay with Optocoupler (2 pieces) | Php. 310.00 – (Php. 155.00 per piece) |
| Stepper Motor Coupler 5 mm. x 5 mm. (1 piece) | Php. 65.00 |
| Plastic Water Flow Sensor 1/2" (3 pieces) | Php. 741.00 – (Php. 247.00 per piece) |
| DS3231 RTC Real Time Clock and EEPROM AT24C32 Module (2 pieces) | Php. 250.00 – (Php. 125.00 per piece) |
| HC-SR04 Ultrasonic Ranging Sensor (2 pieces) | Php. 174.00 – (Php. 87.00 per piece) |
| 12V/24V DC 775 Motor Double Ball Bearing | Php. 499.00 |
| Soil Moisture Sensor Module (2 pieces) | Php. 110.00 – (Php. 55.00 per piece) |
| ¾” x 1 ½” PVC Pipe Reducer (Blue) (1 piece) | Php. 31.75 |
| 1 ½” PVC End Cap (Blue) (1 piece) | Php. 30.00 |
| ¾” PVC Pipe (Blue) (1 piece) | Php. 110.00 |
| 1 ½” PVC Pipe (Blue) (1 piece) | Php. 280.00 |
| ¾” PVC Elbow Pipe (Blue) (2 pieces) | Php. 34.00 – (Php. 17.00 per piece) |
| ¾” PVC Tee Pipe (Blue) (4 pieces) | Php. 96.00 – (Php. 24.00 per piece) |
| Machine Screw with Nut 3/16 (2 pieces) | Php. 7.50 – (Php. 3.75 per piece) |
| Contact Cement Glue (1 piece) | Php. 39.00 |
| Metal Epoxy (1 piece) | Php. 69.00 |
| Drip Irrigation System (1 piece) | Php. 999.00 |
| 12V 3amp Power Supply (1 piece) | Php. 490.00 |
| ¾” Teflon Tape | Php. 10.00 |
| Power bank Module (1 piece) | Php. 300.00 |
| Passive Buzzer Module for Arduino AVR PIC (2 pieces) | Php. 70.00 – (Php. 35.00 per piece) |
| SIM800L V2 5V Wireless GSM GPRS Module (1 piece) | Php. 450.00 |
| 20x4 LCD Display Black on Green (1 piece) | Php. 200.00 |

**Design Models (FDD, Context DFD, Level 0 DFD, Level 1 DFD (so on if possible), ERD)**

Update User

Add user

Notification

Data Logger

Time Management

Relay

Water flow Rate

Network Reading

Data Logger

Network

Time Management

Power Management

Water flow Rate

Soil Moisture Checking

fill

efill

Tank Refill

Drain

Overflow

Tank Refill

fill

efill

Tank Refill

Distribution Discharge

**Hydra: Automated Plant Watering System**

Root Management

Leaf Management

Tank Management

Account Management

**Schedule of Activities (Work Plan-Gantt Chart)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Activities** | **Weeks** | | | | | | | | | | | | | | | **Expected Output** |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** |  |
| Planning |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Analysis |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Development |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Testing |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |