A Microcontroller Based Irrigation System Using Android Application Control.

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ABSTRACT.

To meet up with the increasing food requirement requires rapid and strategic improvement in the technology that will enhance food production. Irrigation as a technique used in the artificial application of water to crops had evolved over decades. However, to get optimum result from the use of irrigation, there is need to automated the system and improve on the techniques of controlling the system in and outside the farm. This project focuses on the development of a microcontroller based irrigation system on emphasis on its control using an android based irrigation app. Using an 800L SIM Module a connection is established between the irrigation system and the android application (APP). The Microcontroller irrigation system is automated using Moisture and Ultrasonic sensors. This system offers the farmers the ability to control the irrigation system many kilometers away from the farm for as long as there is a guarantee of GSM network.

Keywords: Microcontroller, Irrigation, Moisture Sensor, Ultrasonic Sensor, SIM Module.

INTRODUCTION

The use of irrigation to artificially supply water to crops have evolved over many years from the manual methods of using buckets and watering cans to today's highly automated irrigation system. The optimum performance and efficiency of an irrigation system depends on its intelligence (Haritha and Swathi, 2014), (Umeh , et al, 2015) and the flexibility of control the farmer as on the system (Ramakrishna, et al, 2015), (Liai, Meng, Geng, 2013), especially for farmers that travel (Sarika and Sowmya, 2016), (Mritunjay, Sheetal, Shraddha & Diksha, 2016). This project provides a system whereby the farmer can control the irrigation system from an Android device via the irrigation application (APP) by utilizing the GSM technology through an affirmation message of the crop water condition.

2. LITERATURE REVIEW

In times of poor water supply or inadequate rainfall, irrigation had proven to be a good alternate for adequate water supply, thereby artificially supplying the required water needs for crops and vegetation. The effective and efficient performance of an irrigation system is guaranteed through automation and remote control access of the system. Several study and research have gone into remote monitoring and control of irrigation system have been improve upon by many research work. The irrigation system described by (Pavithra and Aromatherapy, 2014) offers users the flexibility to regulate and control the operations of the system via an android mobile device which sends commands and control to and fro the irrigation system. (Haritha and Swathi, 2014) had depicted an intelligent irrigation system that uses sensors for automation and GSM for the system control.

An irrigation system that uses the humidity content of the soil to automate the system by turning ON/OFF the water pump/motor as described by (Mritunjay, Sheetal, Shraddha & Diksha, 2016) using an ATMEGA microcontroller to receive and transmit the signals from the sensors.

3. OVERVIEW OF THE IRRIGATION SYSTEM

The irrigation system layout for this research comprises of the hardware components (Irrigation System) and Software components (Android App). The hardware and software are linked through a SIM 800L Module. The irrigation system layout is shown in the block diagram below.
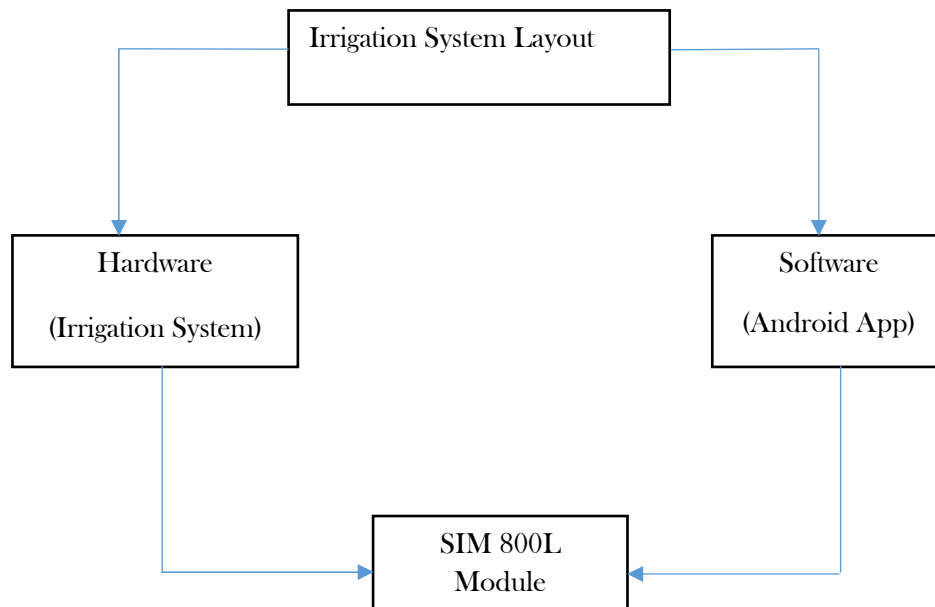

Fig 1: Irrigation System Layout
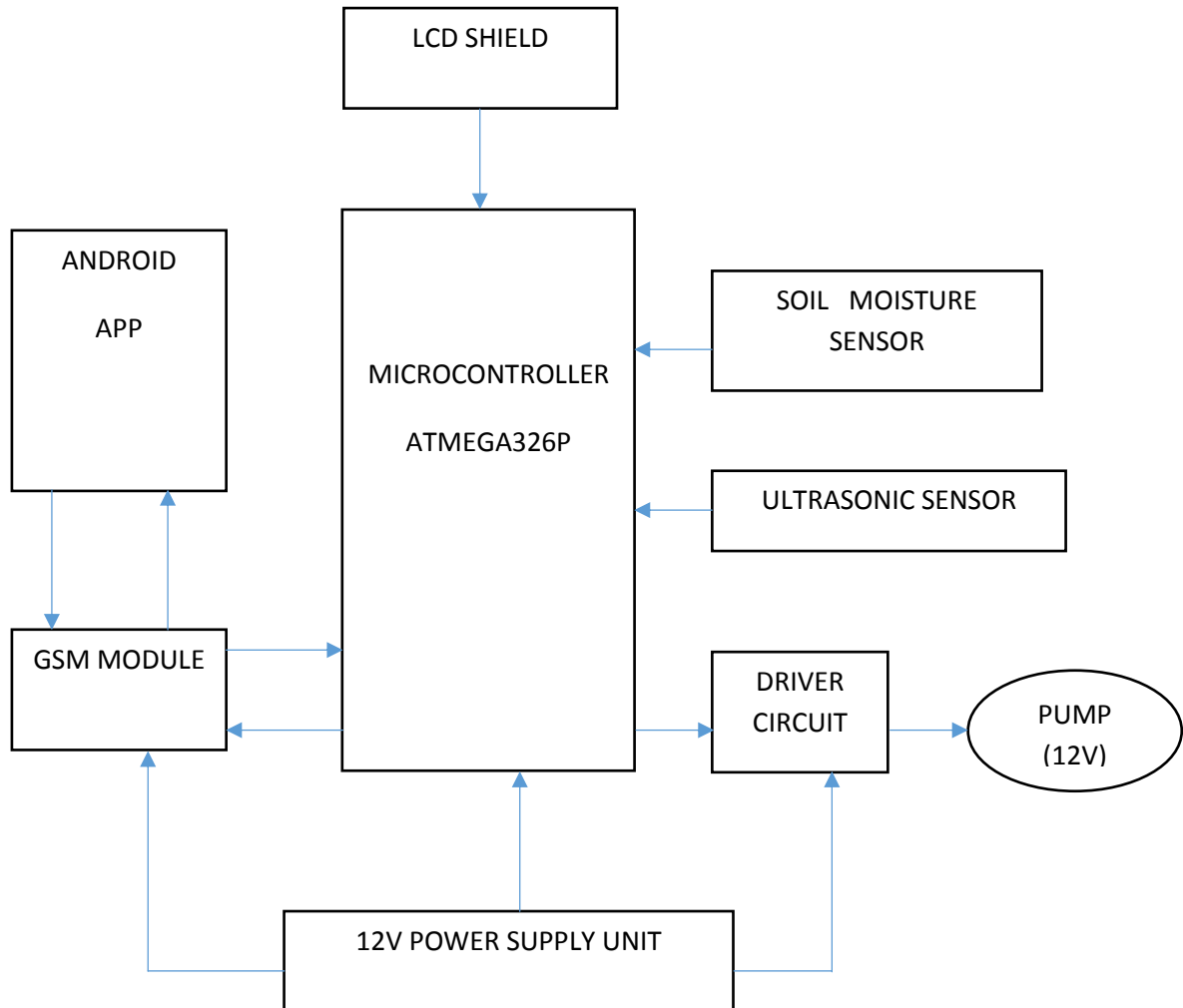
Fig 2: Block Diagram of the Complete Irrigation System

4. THE HARDWARE (IRRIGATION SYSTEM)

The hardware component of the irrigation system comprises of an LCD Screen Display, Power Supply Section, GSM Module, Ultrasonic and Soil Moisture Sensors and a 4-Way Relay Module. At the center of the is an ATMEGA326P microcontroller that controls the activities of the components to and fro the Android App.
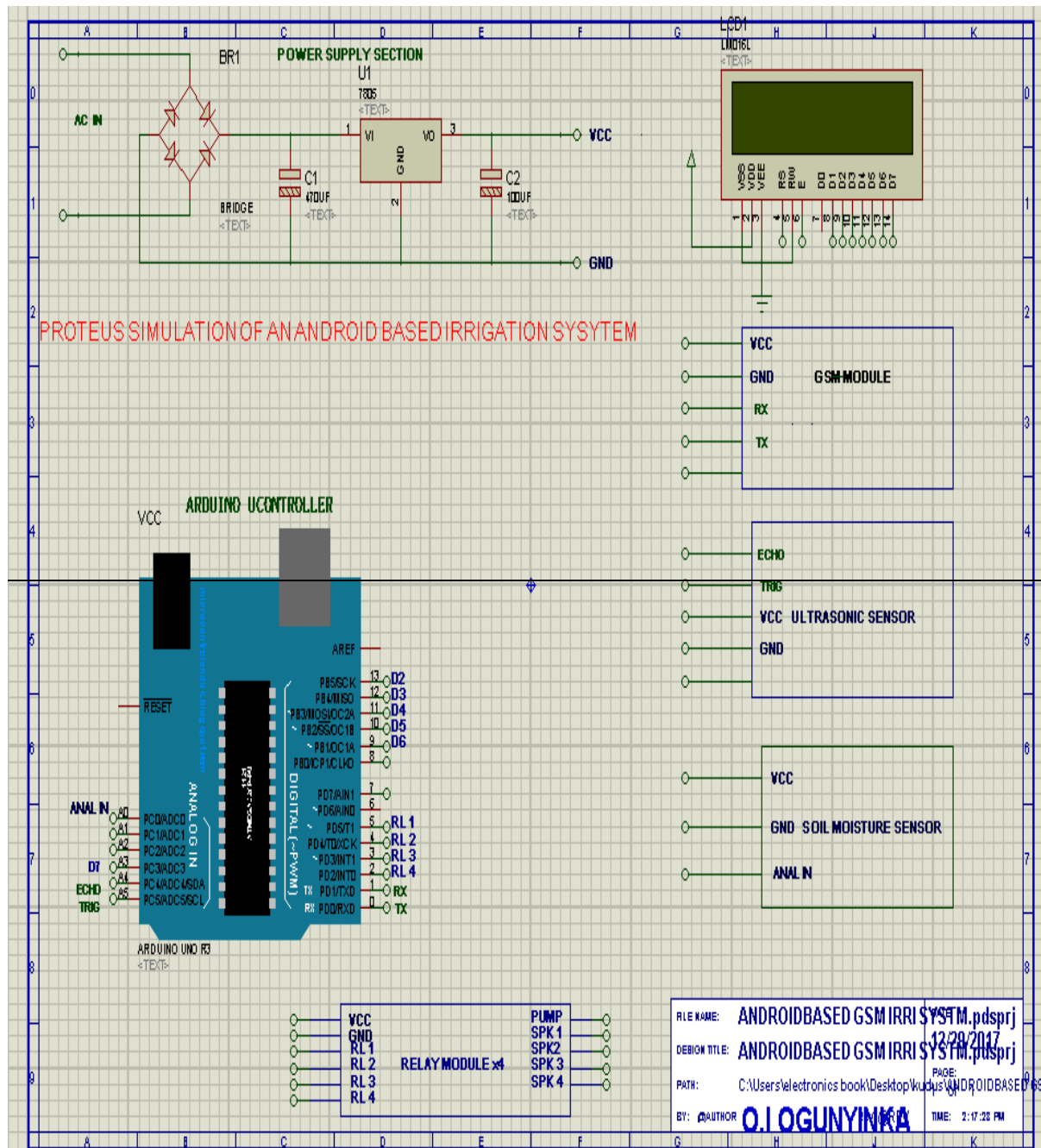
Fig 3: Circuit Diagram of the Irrigation System (Source: Proteus Simulation Software)
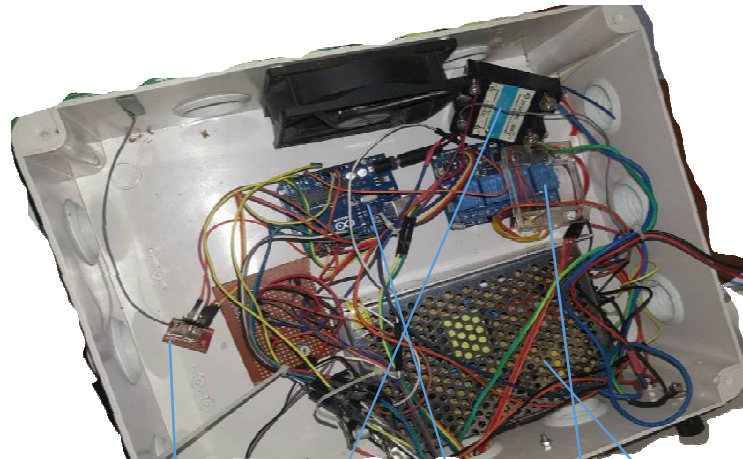
Fig 4: The Irrigation System

800L GSM Module

Arduino Board

12V Power Supply Unit

12V to 6V Power

4-Way Relay

Fig 4: The Irrigation System

Connected to the microcontroller are the following components

i. Soil Moisture Sensor: This monitors the moisture level in the soil. The values taken by the sensor is compared with the rated value of this soil. If sensor value is less than the rated value (Soil Moisture Low) this will activate the pump/sprinklers. On the contrary is the sensor value is higher than the rated value (Soil Moisture High) the pump/sprinkler is turned off. The SIM module receives the signal from the microcontroller and forwards the appropriate message to the android app to either turn ON/OFF the pump/Sprinkler.

ii. Ultrasonic Sensor: This sensor monitors the water level in the tank/reservoir. The upper threshold of the water level is 4000liters of water while the lower threshold is set to 1000 liters of water. Once the rate value of the water falls below the lower threshold the sensor signals the microcontroller and activates the buzzer alarm. Via the SIM module and SMS is sent to the app with in turn activates the water pump to supply water to the tank. Similarly, the app deactivates the water pump on the buzzer indicates that the tank is filled via the sensor.

iii. GSM MODULE: This is the SIM 800L Module that interfaces between the hardware components and the software component. It carries information to and fro the two components of the irrigation system.
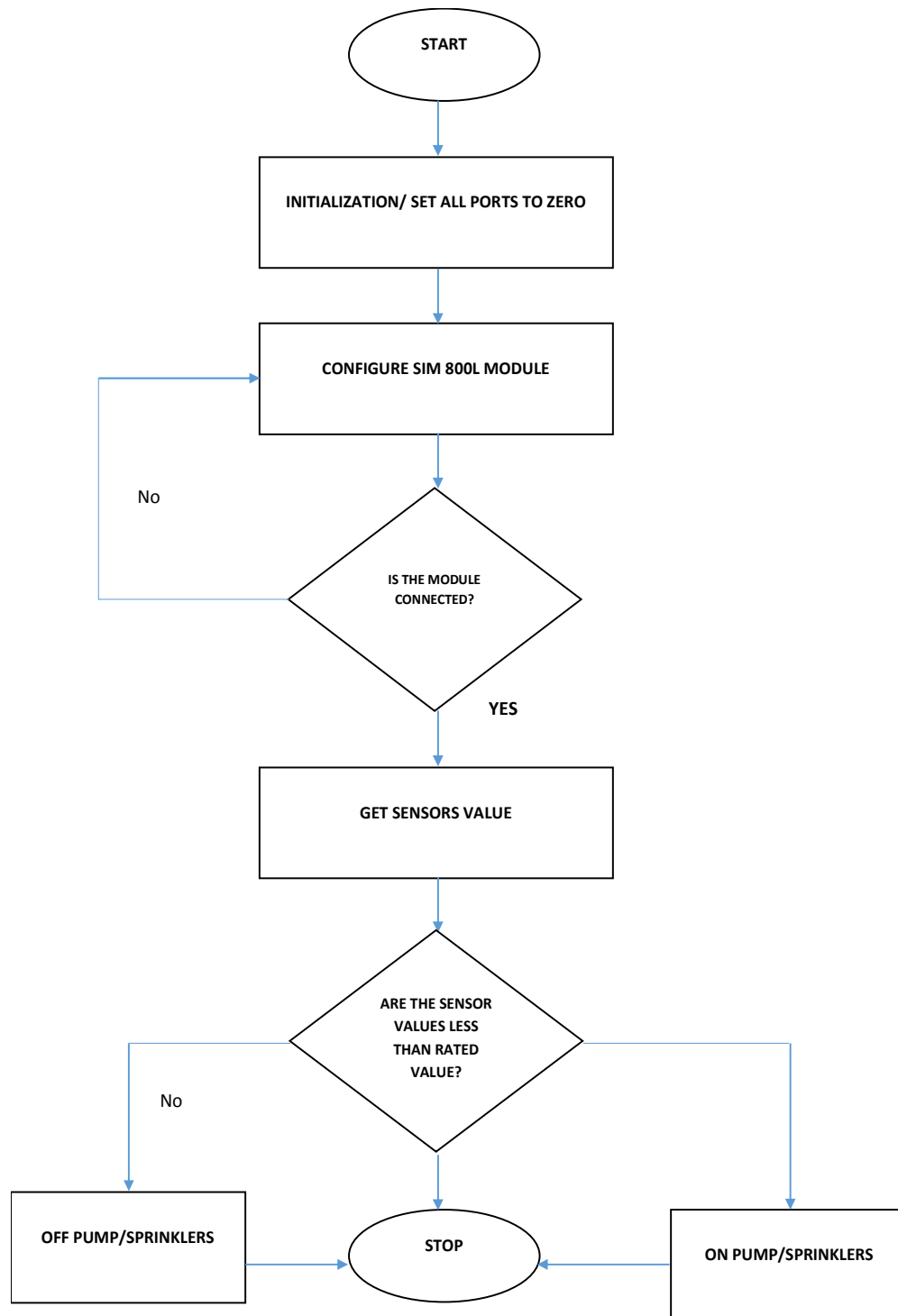
Fig 5: Flow Chart Diagram of the Irrigation System

The operation of the irrigation system is better understood by its flowchart shown in fig. 4 above. The initialization and ports settings of the system commences once the system is turned ON. In other to communicate with the software the SIM 800L Module is configure to establish a connection with the software. Through the microcontroller the current values of the sensors are read and compared with the stored rated values. The resultant values after the comparison determines the action to be taken by the pump/sprinklers.

5. THE SOFTWARE (ANDROID APP)

The APP was designed with MIT APP Inventor; the app makes it possible to connect to the irrigation system remotely. This app works as a GSM remote control that controls the irrigation system.
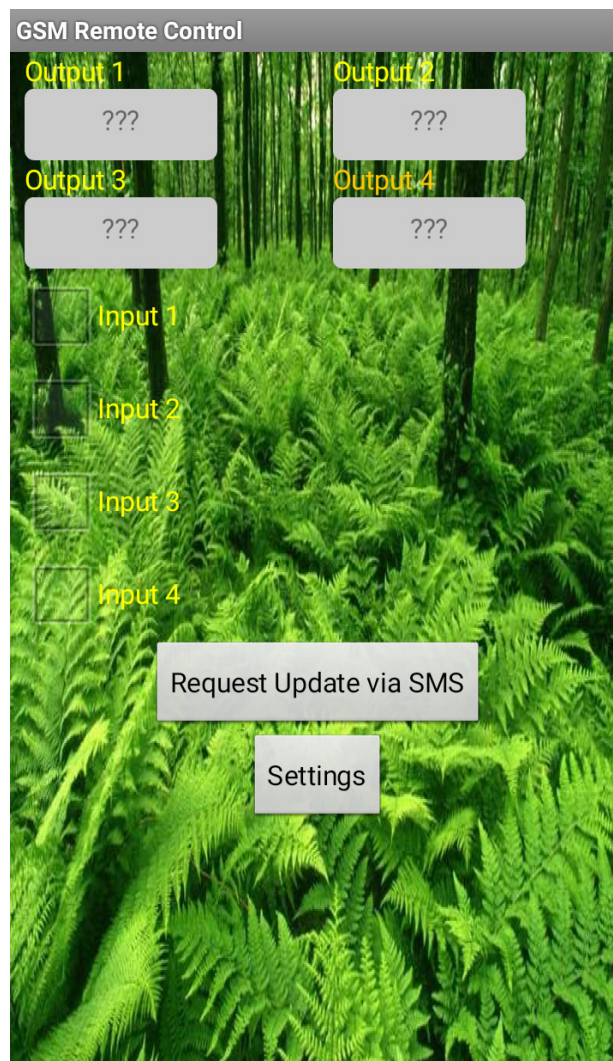
Fig 6: Home Page of the Android App.

The Android app has two screens that appears when the app is lunched;

i.   The Control Interface: This interface shows the status of the irrigation system. This interface represents the Home Page of the App when launched. The launch of the app displays this interface where the default status of each sprinkler is displayed as off. The Sprinklers are labelled Output 1, Output 2, Output 3, and Output 4 respectively. Part of the control interface is the "Request Update via SMS". When this request button is pressed, reading updates from the sensors are requested for via SMS and reading returned to the app via SMS from where it is compared with the rated values. The "Setting" button opens the settings interface of the app where the settings and command from the irrigation system are issued.

ii.   The Settings Interface: This gives setting required to operate the sprinklers and communication to and fro the irrigation system. The Interface is launched from the "Settings" button on the Control Interface. Once the setting is launched the various sections as shown in fig 6 below are shown, where settings for each sprinkler is made. The Status Request shows the last known command issued to the irrigation system and the SMS Number is the number on the SIM Module on the irrigation system which is used to communicate to and fro the system and app. The "SMS on Start" once activated sends a status SMS to the GSM device once a connection is being established between the app and the irrigation system. This is essential to ascertain the connection between the app and irrigation system. The "Save" button saves the settings for future reference and use.

Fig 7: Sections of the Settings Interface.
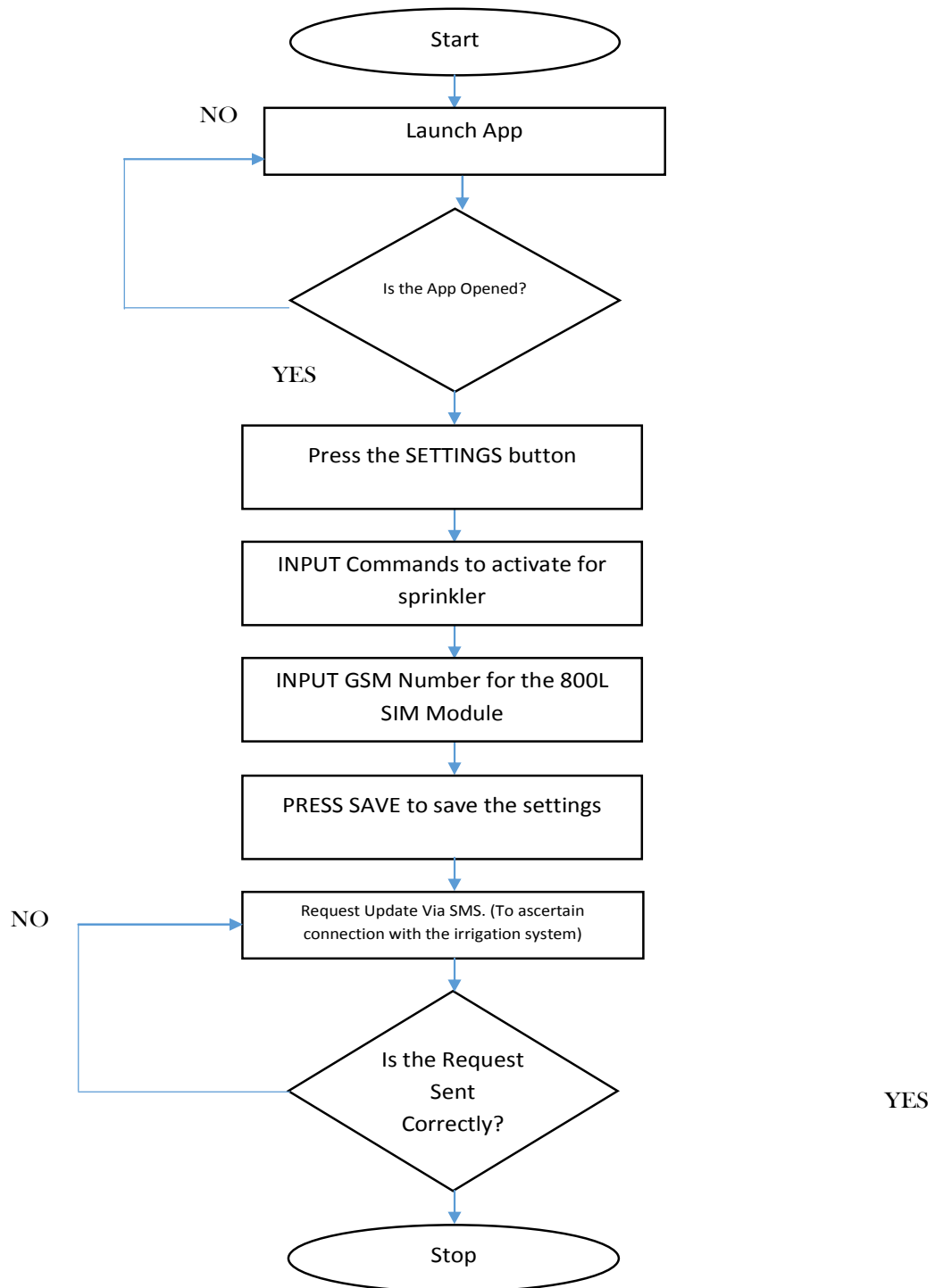
Fig 8: Flow Chart of the Android App for Irrigation System

The flow chart on fig 7 above further explains the operation of the Android App. Once launched from and android device, the app opens displaying the control settings. The app settings are done by opening the menu through the SETTINGS button down the app control setting page. The displayed settings shown the sprinkler and SIM 800L module settings down to the status command as shown in fig 6 above. The SAVE button saves all the settings input for continuous use. Once the settings are made the app is returned to the control setting page and an Update request is made via the SMS by clicking on the "Request Update Via SMS" button. This command request for updated sensor readings from the sensors via the microcontroller.

6. THE OVERALL OPERATION OF THE IRRIGATION SYSTEM AND ANDROID APP

The operation of the irrigation device begins with power being supplied to the irrigation system via the Microcontroller, GSM Module (for connection with the Android App) and the Driver Circuit (a 4 Module Relay Circuit to power the Pump(s)). The initialization process and status upon completion are displayed on the LCD Screen attached. Once these elements are powered and a connection is established between the Irrigation System and the Android App, an SMS is sent to the system via the Microcontroller to get the current readings of the sensors (Soil Moisture and Ultrasonic), that is, the soil moisture content and the tank water level. These readings are sent back to the Android App via the Microcontroller, through the GSM Module. Upon receive, Android App compares the received readings with the pre-intalled rated values in the application to determine the buzzar to sound for necessary action to take place. To the pump for either the sprinklers or the water tank refill the android app sends a command to the driver ciruit via the microcontroller for the pump to ON/OFF depending on the action to be taken. Fig 8 shows the Block Diagram of the Complete Irrigation System.

7. CONCLUSION

This system comes with many benefits and works well with less human involvement. The irrigation system supplies water only when soil mosisture falls below the reference, hence, it conserves water thereby preserving the scares resources (water). Water is further conservered by monitoring the tank water level through a sensor that prevents water to over flow when the tank is water filled. The use of GSM interface had bridged the gap of the farmer's physical presence on the farm, thereby making it possible to start and stop an irrigation process from anywhere within the coverage of the GSM network. The Android app makes the irrigation contol availabel on any android device through the play store. This system finds its use in small and medium scale farming. All these were achieved through the use of microcontroller which monitors all operations of the system.

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