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Voice Authenticated Smart Irrigation

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Abstract: ***A smart and novel way to develop the current farming system has been proposed in this paper. Proper irrigation of crops is one of the most important aspects to produce perfect yield of crops and a good quality product. Untimely and underdeveloped crops are unhealthy and cannot be marketed. Also, unnecessary irrigation and improper farming significantly wastes water resources. The aim of this paper is to produce a methodical way of irrigation in which the farmer can practice irrigation from any remote location at any particular time. The farmer can easily identify the status of the motor through a voice authentication in his/her own regional language. This helps the farmer be aware of the irrigation status. This data will be displayed on a screen with the help of General Packet Radio Service (GPRS), thus giving the farmer easy access from any place. The main goal here is to rekindle the interest in youngsters to consider agriculture seriously in the future and to make it easier for farmers to practice farming in a techno friendly manner.***

Key words: any remote location, status of the motor, voice authentication, regional language.

I. INTRODUCTION

Agriculture is the process of producing food, feed, fiber and many other desired products by the cultivation of certain plants. The whole world depends on agriculture even though they do not realise it. It is the single largest livelihood provider of India, more so in the rural areas[13]. It contributes a very significant percentage to the Gross domestic Product (GDP) of India[3]. It is key to the growth of human civilization[15].

Sustainable agriculture, in terms of food security, rural employment, and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection, is essential for holistic rural development.

Today's youngsters however do not understand the importance of agriculture to the economy and the food industry and mock it for being backward and just a countryside business. Slowly more and more farmers are giving up their lands and profession as they feel that they have fallen behind in their economic status[14]. There are current four systems in irrigation of agriculture, they are:

1. Surface irrigation
2. Drip irrigation
3. Hose irrigation
4. Flood irrigation

All these types of irrigation happen with no timer, no status recognition and at random which results in a huge loss of water and water resources. Sometimes, it also leads to crops being over watered[2], which might result in the withering of crops[6]. This happens due to the farmer not knowing the status of his motor[1]. This project helps the farmer to know the status of his motor and to carefully regulate it[10].

The main area concentrated in this paper is irrigation which will help farmers to regulate and switch on/off their motors from a remote location without requiring actual physical presence.

This research aims at developing a system which will encourage future youngsters to take up agriculture as a profession of engineers and not just another old man's business. It encourages this in a modern and sophisticated manner in lieu of the traditional methods which have been in practice for centuries[3].

The system provides two modes- one targeted towards literate farmers, where they can receive a SMS on the status of the motor and the other towards illiterate farmers, who will receive a voice authentication in their regional language regarding the motor status[1]. To enhance the support given to the farmers, the data will also be displayed on a screen with the help of General Packet Radio Service (GPRS).

The security feature of this project is one of its highlights as only the mobile number which has been pre- registered to the SIM can be used. No other mobile number can switch on/off the motor thus ensuring total security and reliability.

Ultimately the proposed system will make irrigation easier for farmers by giving them access to technology which will help them effectively control the motor.

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II. SYSTEM DESIGN

A.BLOCK DIAGRAM:

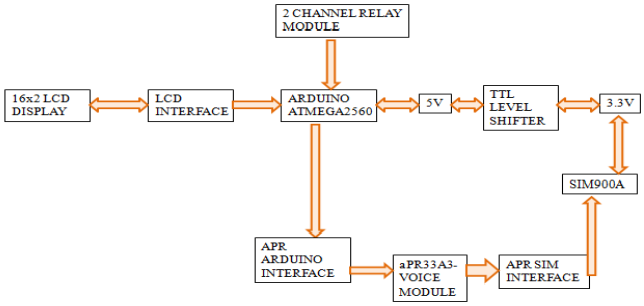


Figure 1. Block Diagram

The above block diagram represents mode 2 system. Mode 1 system is simply a part of the above system excluding the APR voice module, APR-Arduino Interface, APR SIM Interface. Mode 1 is the simple mode which is predominantly designed for illiterate farmers. The components of the mode 1 system are the DC motor, 2-channel relay, Arduino, LCD display LCD interface, TTL shifter and GSM Module(SIM900A).These along with the aPR33A3 voice module, APR Arduino interface and APR SIM interface. They can control the motor using SMS. Mode 2 is the voice mode which is designed for more literate farmers. This syste includes all the mode 1 components along with the aPR33A3 voice module, APR Arduino interface, APR SIM interface. The farmer gives the appropriate combination of keys on his/her mobile to switch ON/OFF the motor. The status of the motor is given out in the phone in regional language.

III. COMPONENTS INVOLVED

The main processor/controller used here is the Arduino ATmega 2560 manufactured by Arduino. The ATmega2560 is a low- power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega2560 allows the system designer to optimize the power consumption versus speed ratio. It has 15 analog input ports and 54 digital input ports. It also has 4 USART ports. It operates in the range of 7-12V/1A. It is used because it was found to have the most optimal interfacing techniques with respect to the components used.

The device is manufactured using the Atmel high- density non-volatile memory technology. By combining an 8-bit RISC CPU with in-system self-programmable flash on a monolithic chip, the Atmel ATmega2560 is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. This device can be programmed using the C language or the built in AVR systems language.

The SIM card module used in this paper for communication relay purposes is the SIM900A module. This SIM module is a dual-band GSM/GPRS solution which can be embedded in customer applications. It can be used for the DTMF feature[4], which is applicable in this paper. The DTMF feature is very robust in the 900A model when compared to other older models such as the 800 and 700 SIM modules. This SIM can be easily interfaced with the Arduino processor using a 3V and 5V transformer.

The aPR33A3 is the voice module system used in this project. It is manufactured by APLUS integrated circuits. It can do both playback and record audio/voice. It is an 8 channel system. It is a single chip voice module. It can do high quality audio/voice recording & playback which is used for Arduino interfacing. It has a 16 bit digital audio processor. Its operating range is 3-6.5V DC. The resolution is upto 16 bits. This helps is producing perfect clarity in the regional language. The desired regional language is pre recorded into this voice module using a playback channel and then sent to the speaker through the string function when called.

The Arduino Relay module allows for the usage of a wide range of microcontrollers such as Arduino, AVR, PIC, ARM with digital outputs to control larger loads and devices such as AC/DC motors etc. This relay helps in the motor regulation used in this research project. The module is designed with the capacity to control 2 relays. Both these relays are end to end and can be controlled from either side. In this paper, we are controlling the relay only from one side. This system switches the ON/OFF status of the motor.

Transistor-transistor logic (TTL) is a digital logic design in which bipolar transistors act on direct-current pulses. They are typically fabricated onto a single integrated circuit (IC). Since the GSM module and the Arduino module require different voltages to operate at their efficient standards, a TL is used to regulate the voltage supply output at both ends. A standard TTL circuit operates with a 5-volt power supply. A TTL input signal is defined as "low" when between 0 V and 0.8 V with respect to the ground terminal, and "high" when between 2 V and 5V. It is used here to interface the Arduino with the SIM900A.The other interfaces used here are Arduino-LCD, Arduino-voice and SIM-voice interfaces.

IV. TABULATED LIST OF COMPONENTS USED AND SOFTWARE USED:

Table 1. Summary of components used

ATMega 2560	Arduino Microcontroller
Power Module	Used for providing voltage supply to Arduino, GSM, relay and ATMega2560 and voice module.
aPR33A3	Switching circuit for Sound/Voice Module
LED/LCD	Status display (16x2)
SIM900A	GPRS/GSM Module
Bridge rectifier	12V unregulated/5V regulated DC
2 channel relay module	Motor ON/OFF
TTL shifter	Interface between SIM900A and Arduino
Arduino-aPRA33 voice module interface	Switching circuit for appropriate voice command.
DAC Interface	Acts as the interface between SIM900A and aPRA33 voice module converting digital input to analog output
Arduino LCD interface	Interface between LCD and Arduino.

There are 2 software used here- Arduino IDE and DWEET. The Arduino Integrated Development Environment (IDE) is the standard software used while working with the Arduino. It is a cross-platform application that is written in the programming language Java. It is used to write and upload programs to Arduino board. In the case of this system, the code which is used to interface the Arduino and GSM, and the Arduino and voice module is written into the IDE. Once it is successful, the program is dumped/loaded onto the hardware system by a loader program in the board's hardware.
DWEET.IO is a public Internet of Things (IOT) platform which acts as a simple publishing and subscriber for machines, sensors, devices, robots, and gadgets. The published messages are called 'dweets'.DWEET.IO can be thought of as "Twitter for things" It is easy for the farmer to use, as he/she need to only open the page without having to log in or create an account. The software enables the machine and sensor data to become easily accessible through a web based RESTFUL API, allowing one to quickly make apps or simply share data. A unique variable name is assigned to a particular project. In this case, the name "Project 456" has been given on DWEET. Then a project may be subscribed to by another farmer or someone else, which is analogous to following someone in twitter. The main code is linked to this platform. This platform is used to display the motor status of the system. The GSM relays the information to this platform which in turn displays the ongoing motor status. This can be accessed easily from any system anywhere.

V. FLOWCHART

In Mode 1, the user receives a Test Confirmation SMS from the driver. In this mode, the driver refers to the circuit consisting of the GSM Module(SIM900A) and the TTL Circuit(which acts as the interface between the Arduino and the GSM module). This tells the user to start the test of the motor. When the user sends the command MOTOR ON via SMS to the registered number ,the relay is activated and the motor is switched ON. To switch off the motor, the user has to send the command MOTOR OFF via SMS. The relay is once again activated and the motor is switched OFF. The status of the motor is displayed on the LCD. This flowchart is shown in Figure 2.

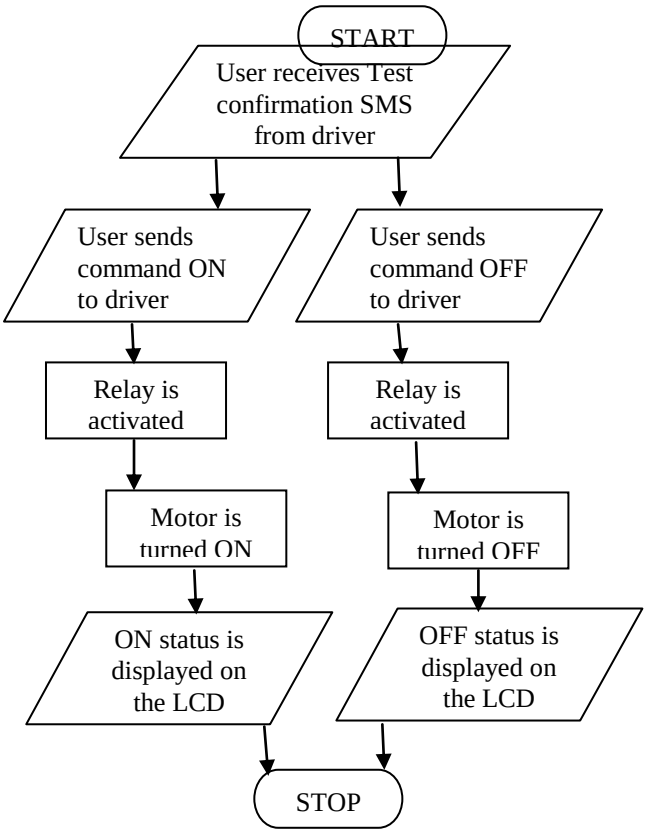
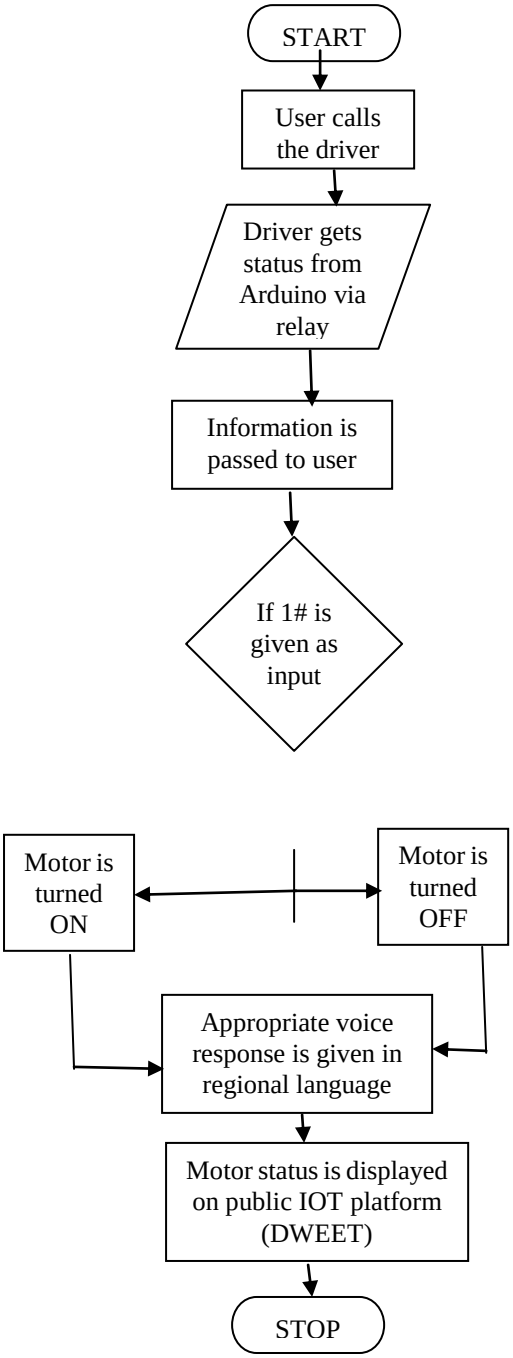


Figure 2. Mode 1- Flowchart

In mode 2, the user calls the driver. His/her mobile number should be registered to the SIM. It is advisable to use a sim whose service provider gives consistent mobile network. The current status of the motor (ON or OFF) is communicated from the relay to the Driver via the Arduino. The driver here is the circuit consisting of the DAC interface and the Arduino APR interface(which acts as the interface between the Arduino and the voice module).Depending upon the input given by the user,the motor can be turned ON or OFF. If 1# is given as input, then the motor is turned ON, else it is turned OFF. This information is passed to the Arduino which in turn passes this to the voice module aPR33A3. The voice module gives an output message regarding the status of the motor in the appropriate regional language. This status is also displayed on the public IOT platform DWEET. It can be accessed by the farmer at any time from any remote location. The flowchart for this mode is shown in Figure 3.

Figure 3. Mode 2-Flowchart



VI. METHOD OF INTERFACE

The Arduino is individually interfaced with the LCD, SIM900A, Voice module and the 2 channel relay module as an input to output interface. All these interfaces are then combined and projected together.

The TTL Circuit is placed between the Arduino and GSM Module. Since the Arduino works on a voltage of 5V and the GSM Module works on a voltage of 3.3V, they cannot be connected directly. DC level shifting must be done to ensure smooth working of both components. The TTL Circuit serves this purpose. It consists of 4 2N700A MOSFET's whose terminals are connected to 10k resistors.

The Arduino ATMega 2560-aPR voice module interface circuit is placed between the Arduino and aPR33A3 voice module. It consists of 5 Bipolar Junction Transistor (BJT)'s whose base terminals are connected to the Arduino digital pins via 1k resistors and whose collector terminals are connected to the input pins of the voice module. The circuit acts as a switching circuit where each transistor goes to HIGH to access the appropriate command from the appropriate pin in the voice module.

The voice-SIM interface circuit is placed between the GSM900A Module and aPR33A3 Voice module. It works as a Digital to Analog Converter (DAC) circuit, in the sense that the digital input from GSM is converted to analog output going to the aPR voice module.

The LCD Arduino Interface simply involves direct connections from the digital pins of the Arduino to the LCD pins. The 10k potentiometer in the circuit can be adjusted to control the LCD glow, suitably controlling its brightness.

Only the registered user number can call the GSM for controlling the motor. If any other unknown number calls the system, the user is denied access. This feature is one of the main highlights of this system. This allows only the legitimate user to control the system and no outsider can access the system through fraudulent means.

VII. REAL TIME TESTS

The components were all interfaced and a test run was done.

This resulted in the motor application running successfully with the help of the DTMF enabled mobile phone. There was also voice acknowledgment in the desired regional language of the farmer from the voice module over the status of the motor. The respective status was also displayed on DWEET. This was a successful test.

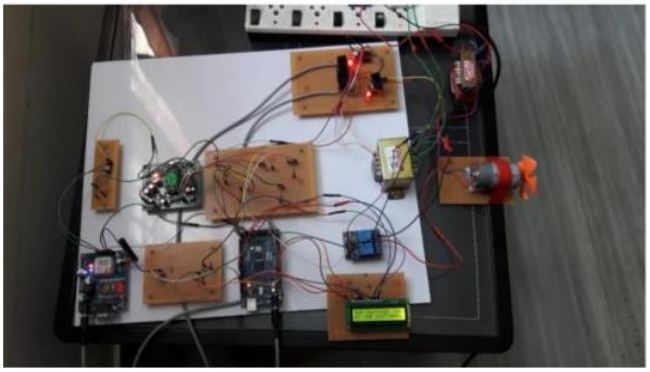
In the other operational mode, the motor was switched on and ran successfully and the status of the motor was conveyed to the farmer over the SMS through his mobile.

The system was also tested over a single phase energy system since most farmer do not receive the three phase power system and this module was also implemented successfully

All these tests were run with the help of a normal DC motor. Since the working of the DC motor and the water pump is the same, it is expected to be implemented successfully.

A couple of test results are shown in the following figures:

Figure 4. Mode 2- Motor OFF



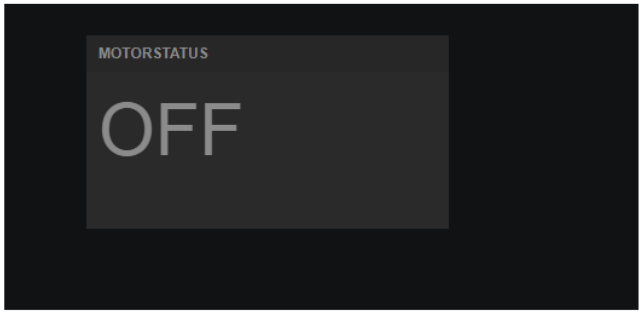


Figure 5. Motor OFF status on DWEET

VIII. CONCLUSION AND FUTURE WORK

From the real time tests and from actually running the system, it can be concurred that the system is a successful development from the old irrigation models. It can be successfully used in the real time world.

The cost of the system and its installation as mentioned above is also very less and is a practical usage applicant. The motor usage status of the system is successfully provide and shown as output.

This system has successfully provided regional language (Tamil) authentication for the status of the motor with the usage of a mobile number.

This information is also displayed on a web based application(DWEET).

Further developments in this system would be to incorporate the use of a mobile app to control the motor status. This app would be a cloud based app and could also be made available in the regional language for the farmer to easily use it. The DTMF concept may also be used to select a particular regional language for the convenience of the farmer involved.

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