Automated Alert Fencing System Using Arduino and GSM SIM Module

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Abstract: *The objective of our project is to provide an automated system alert fencing system for warding off animals from farms using Arduino (microcontroller) and easy-to-use mobile application. Today, in rural parts of India, manual intervention by farmers is required to ward off the animals that frequently intrude the fields and damages the crops. This incurs a lot of economic and time drain on farmers, and it requires checking their fields in regular intervals of time. The aim of our project is minimize this manual intervention by farmers and save their time and resources using automated alert fencing system.*

Keywords: Arduino, ultrasonic sensor, mobile application, GSM module, solar fencing, alarm system

1. Introduction

Agriculture plays a vital role in the Indian economy. Over 75 percent of the rural households depend on agriculture as their principal means of livelihood. Recently in India, there have been many technological advancements in the agricultural sector, but warding off wild animals, which trespasses the farms, is still being done manually. In rural parts of India where farmers are not usually well versed economically and technically suffer from hefty loses to these frequent animal intrusion and require a constant manual lookout to protect their fields against such intruders.

Crops are usually destroyed by these wild animals and result in large amount of loss to the farmers. A constant manual guarding of the fields is not possible. To tackle this problem, in our proposed work, we shall design a system to prevent the entry of animals into the farm and alert the farmer at the same time via a phone call. Our main purpose is to develop an inexpensive and prohibitive fencing to the farm to cut losses due to animals. The developed system will not be harmful to animals. Theme of project is to design an intelligent security system for farm protection by using embedded system.

Firstly, the fields are protected by a solar fencing system, which uses energy from solar panels to drive an electric current through the wires of the fences, that wards off animals by giving them a safe electric shock. If in some cases, small animals like rabbits, manage to enter the farm, then ultrasonic sensors are used to detect their presence. The sensors send the data to the microcontroller which turn on the alarm system which consists of sounds and damping lights. The microcontroller then informs the user by an automated phone call via GSM module and he can decide to turn off the alarm if so desired.

2. System Architecture

2.1 Key Components: Description and Uses

2.1.1 Microcontroller (Arduino)
The controller receives signal from the ultrasonic senor and commands from mobile application. The controller responds by turning the alarm OFF after it has been triggered by an animal intrusion. Once the task is completed, it notifies the user of the same.

2.1.2 Ultrasonic sensor
The ultrasonic senor is used to detect the entry of an animal within the premises of the farm boundary. Once the ultrasonic signals of the sensor are blocked by an animal, it immediately reports back to the microcontroller.
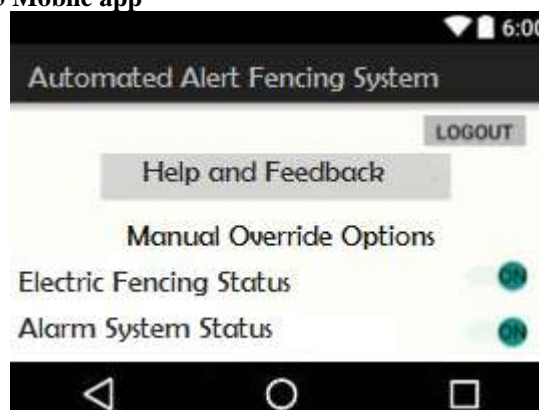
2.1.3 Mobile app

Figure 1: Mobile application

Mobile app is used to connect user with the automated intrusion alert system. The user is provided with an unique identification (ID) and password which is required to login the application. Once the user has logged in, he can control the alarm and lights of the farm.

2.1.4 Relay
A relay is an electrically operated switch. Many relays use and electromagnet to mechanically operate the switch and provide electrical isolation between two circuits. Since the fence works on high AC voltage, the sensors can't be directly connected to them. Instead the sensors are connected to relays which in turn are connected to controller and the ac power source. These relays electrically isolate ac power source from controller and prevent it from any damage. Relay use dc input of small voltage for triggering and are ideal to use with a controller. Controller can trigger the relay to close the circuit of ultrasonic sensors and ac power supply.

2.1.5 Solar Panel

Solar panels get energy from the sun for people to use. There are two types of solar panels, those that collect heat (thermal), and those that produce electricity (photovoltaic). Heat from solar panels is often used for space heating and for hot water. Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

2.2 Hardware Requirements

2.2.1 Arduino Uno R3

Figure 2: Arduino Uno R3

It is a microcontroller [3] board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

2.2.2 Atmega 328p

8-bit AVR [4] RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timers/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages),programmable watchdog timer with internal oscillator..

2.2.3 Relay

Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. Arduino cannot control high voltage and current, but a relay can do this job.

There are three configurations of relay:
1) COM = Common Connection
2) NC = Normally Closed Connection
3) NO= Normally Open Connection
Here we have used NO configuration as it acts like a switch since this configuration is open – there will be no contact between COM and NO. When we trigger the relay module, it connects to COM by the electromagnet inside the relay and supply to the load is provided, which switches the alarm OFF.

2.2.4 SIM 900 GPS/GPRS

Figure 3: GSM SIM module

SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

2.2.5 Solar Panels (Power supply Unit)

Solar panels absorb the sunlight as a source of energy to generate electricity or heat. A photovoltaic (PV) module is a packaged, connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 Watts (W).

2.2.6 Software Reqirements

1) Programming languages: Java, SQL
2) Arduino IDE: To program Arduino
3) AndroidStudio: To build and program Android application
4) Platform that support android: Android emulator or any mobile on android platform.

3. System Working

Once user has logged in the mobile application, he gets access to control the functionalities of the microcontroller. Then the user can manually turn on the solar fencing for the required time period.
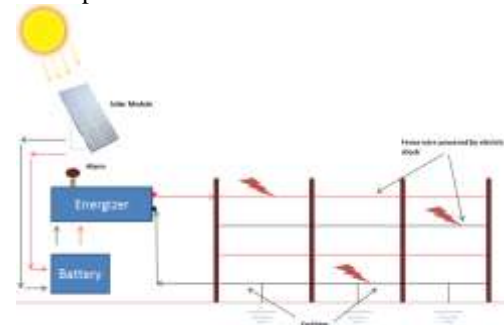

Figure 4: Basic design of the system

The solar fencing provides first layer of defense against animals to protect the farm from intrusion. If the animal happen to come in contact with any wire of the fence, then it

is given a shock of minimal intensity (unharmful) to ward it off. If in certain scenario it manages to surpass the fence, then ultrasonic sensors come in use as they detect the presence of the animals.
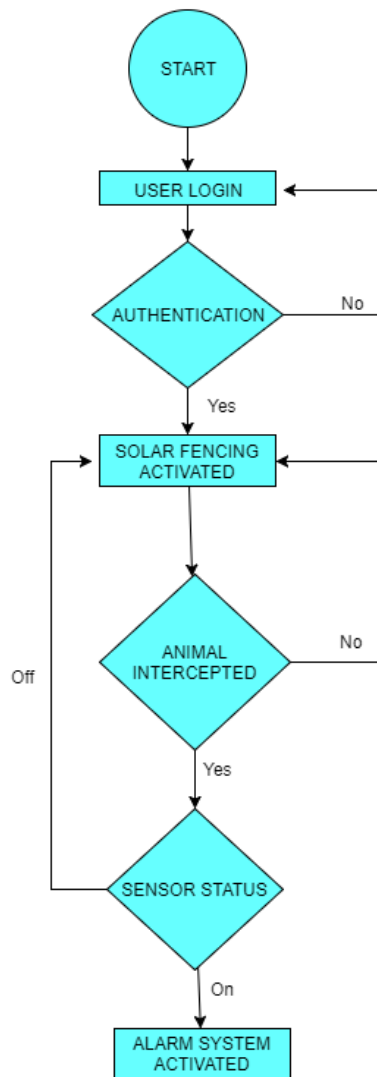

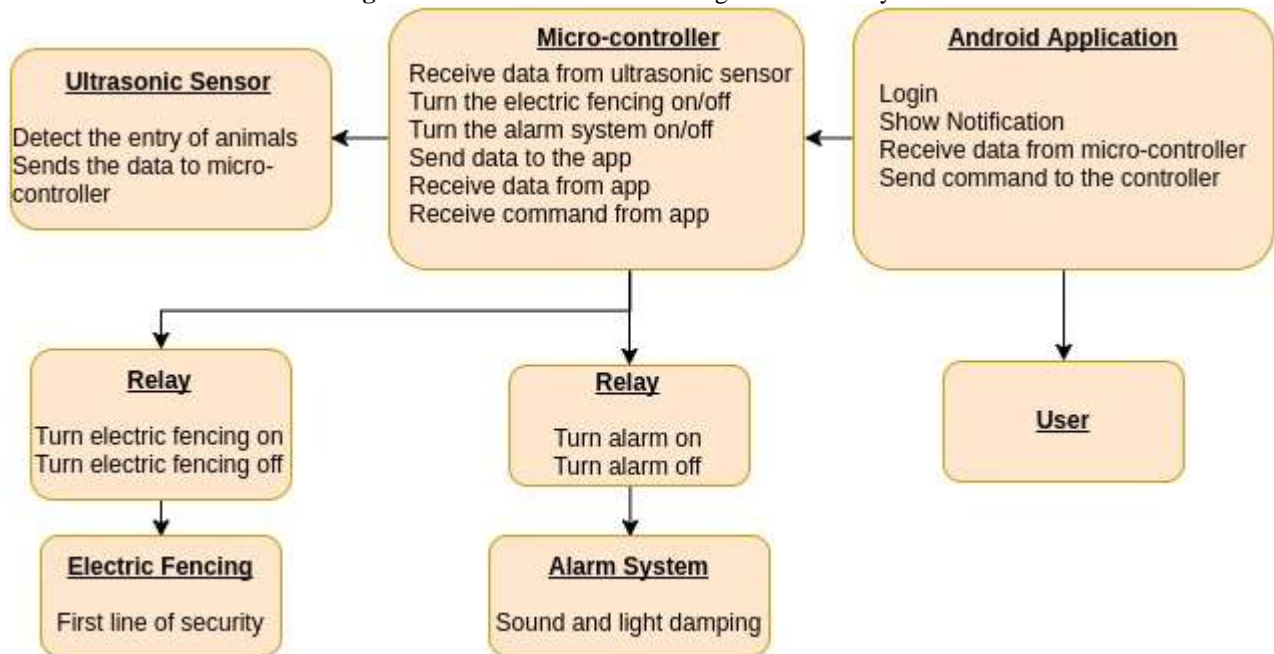**Figure 5:** Flowchart for the working of the alarm system

Figure 6: Class Diagram of the System

If the ultrasonic sensor detects an intrusion of an animal, it sends information to the microcontroller (Arduino Uno R3) about the presence of animal in the field. Microcontroller processes this information and further sends a triggering signal to relay. When the relay is triggered, it changes its configuration from No (Normally Open Connection) to COM (Common Connection) by the electromagnet inside the relay and supply to the load (alarm system) is provided. The circuit is closed until we trigger the state of relay to low. Once the alarm starts, a sound is sent out from the speakers and the lights placed on the fields start damping. The sound of the alarm is so set that the animal gets frightened and runs away from the field.

Furthermore, an automated voice call is made to the user cautioning him about the intrusion of the animals. The user can then decide whether to turn off the alarm system from the provided mobile app.

4. Conclusion

Alarm system using Arduino and android mobile application is useful for farmers as it saves their time and resources. It provides useful warning regarding the intrusion of animals in their fields, thereby protecting the crops from possible hefty losses. It significantly reduces manual labour of watching the farms day and night. Furthermore, the mobile application brings out the possibility of accessing the system from any place at any time which is very important in this modern era of technology.

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