"WIRELESS CROP-FIELD PROTECTION SYSTEM"

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ABSTRACT

Agriculture plays vital role in the development of agricultural country like India. Issues concerning agriculture have been always hindering the development of the country. But now a days our crops are affected by various problems like birds, animalsand human thefts. So here we proposed a design of electronic system to protect crop field from multiple security threats like birds, animals and human thefts.

In this system, we focused on 3 parts; which are: Motion detection at compound, motion detection inside field and alert generation. Main objective is to protect crop field from different animal and birds without any external human help. For this purpose, a high frequency buzzers are used in crop field which activates on detecting motion. If the motion stays longer IOT alert for intruder will be given to owner. To connect multiple sensor nodes with base station, RF signal transmitter are used. Where as to connect base station with webpage, ESP8266 Wi-Fi module is used.

Keywods: wifi, IOT, ESP 8266, Farming, crops, detection, visualization

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Introduction

The Internet of Things (IoT) is about making things smart by connecting them to each other and to the internet [2]. It enables physical objects to be sensed and controlled remotely, creating opportunities for more direct integration between the physical world and computer-based systems. Devices can be remotely monitored and controlled in real time, and can include anything from pumps, sheds and tractors to weather stations and computers. On farms, IOT allows devices across a farm to measureall kinds of data remotely and provide this information to the farmer in real time. IOT devices can gather information like soil moisture, chemical application, dam levels andlivestock health - as well as monitor fences vehicles and weather.

Sensor networks are used for collecting, storing and sharing the sensed data. They can also be defined as a system comprised of a set of sensor nodes and a communication system that allows automatic data collection and sharing. Automation in agriculture brings about a fundamental contribution to what is now known as precision agriculture (or precision farming). In recent time, the wireless sensor network technology has found its implementation in precision agriculture as a result of the needfor high productivity [6].

Agriculture is the most important pillar of Indian Economy. More than half of the Indian population is dependent on agriculture for its subsistence. But farmers alwayssuffer from multiple security threats in crop field. Many times animals and birds enter into crop field and cause destruction of crop or product. Other than this, there are so many cases in which fruits are stolen from crop field and cause the loss of thousands ofrupees to the farmer. So to protect the bone of

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Need of Project

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Objectives of Project

Now a days our crop fields are affected by various problems like birds, animalsand human thefts. So here we proposed a design of electronic system to protect crop field from multiple security threats like birds, animals and human thefts. Objectives ofthe system are:

- Immediate IOT alert will be generated on detection of intruder.
- Monitoring of crop field at compound and in inside area.
- High frequency noise will be generated to scare the birds and animals.
- If intruder gone after noise generation, it will be considered as bird/ animal.
- If intruder remains even after noise, alert will be generated.
- 24*7 monitoring and alert.

SYSTEM DEVELOPMENT

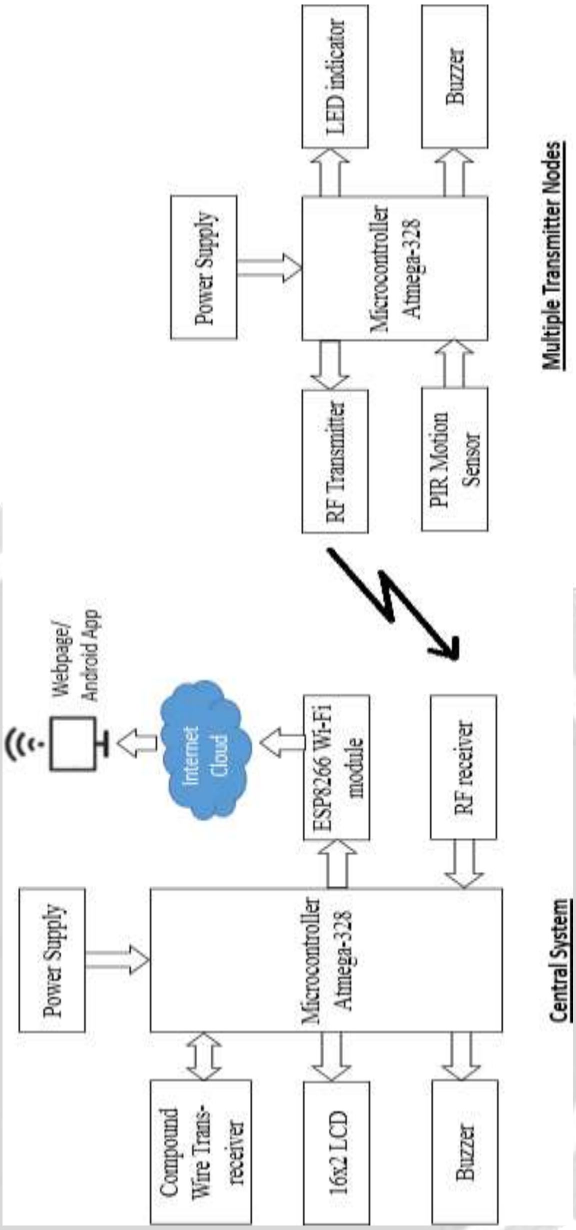
Project Specifications

While developing any microcontroller based electronic system, there are somesteps which must be followed. These steps are:

1. Deciding system specifications i.e. Block diagram
2. Selection of system components
3. Design of circuit diagram
4. Design of microcontroller program
5. Simulation of circuit
6. Design of PCB layout
7. Manufacturing of PCB layout
8. Component mounting & soldering
9. Testing and troubleshooting of hardware
10. Design of enclosure or structure if any

Block Diagram

In this system, multiple nodes will be planted across crop field with motionsensors. This sensors will detect the motion and send alert to central system usingencoded RF signal. It will also produce the different high frequency noises to scare theanimals and birds. Whereas, on



detection of alert signal, central server upload that dataon IOT webpage with the location of corresponding node. If signal stays even afternoise generation, an alarm will turn on and intruder alert will be generated on webpage.To monitor the compound of crop field, a digitally encoded signal line is routed through compound wall, which will also able to generate alert on breaking or connectedto earth. Central system will continuously display readings from nodes on webpage through internet. So that farm owner will be alert at that exact movement and can takeimmediate action. To connect system with webpage, ESP8266 Wi-Fi module is used.To display all operation LCD display of 16x2 matrix is used. Buzzer is used to providealert in case of any intruder detection etc. Both display and buzzer will be controlled bymicrocontroller. Power to the system is provided through regulated power supply of 5V and 3.3V. All components need 5V DC supply except Wi-Fi module which need 3.3VDC.

Figure 1: System Block Diagram

Design & Interfacing

Interfacing of LEDs:

The 0.5mm LED needs a supply of 1.7V and 10mAmp maximum to glow at full intensity. The HIGH signal at the microcontroller output pin generated 5V and 200mAmp maximum current which is sufficient for LED. So it can be directly connected to the output pin of microcontroller. To protect the LED from higher supplycurrent and voltage, a resistor in series is needed. Value of that current limiting resistorcan be calculated with:

$$R= (V_{in}-V_{led})/I_{led}$$

Where: V_{in}= Input voltage to the LED

V_{led}= Maximum voltage required for LED

I_{led}= Maximum current required for LED

So, $R =(5V-1.7V)/ 10mA$

$=330$ Ohm

LEDs of different light and wattage consumes different current and so the ideal value for current register also changes. Though 330ohm resistor works for all the 0.5mm sizeLEDs.

Interfacing of Buzer

The digital buzer needs a supply of 5V and 50mAmp maximum to generate sound at full intensity. The HIGH signal at the microcontroller output pin generated 5V and 200mAmp maximum current which is sufficient for buzer. So it can be directly connected to the output pin of microcontroller.

Interfacing of Switch with Microcontroller

Pull-up resistors are resistors used in logic circuits to ensure a well-defined logical level at a pin under all conditions. If it is neither in a high or low logic state, the microcontroller might unpredictably interpret the input value as either a logical high orlogical low. Pull-up resistors are used to solve the dilemma for the microcontroller by pulling the value to a logical high state, when switch is not pressed. Without the pull-

up resistor, the MCU's input would be floating when the switch is open and pulled down to a logical low only when the switch is closed.
In case of microcontroller, TTL logic LOW has voltage level between 0 to 0.8V where as logic HIGH has voltage level between 2 to 5.25V with minimum current of 200uAmp. So to keep microcontroller at logic HIGH, the minimum voltage needed is 2V and the minimum sink current required of 200uAmp. To provide sufficient current,300uAmp current can be considered. So the value for pull up resistor will be

$$R_{pullup}= (V_{in}-V_{min})/I_{min}$$

Where: V_{in}= Input voltage

V_{min}= Minimum voltage required for HIGH logic

I_{min}= Sink current for microcontroller

So, $R_{pullup} =(5V-2V)/ 300uA$

$=10$KOhm.

Design of Crystal Oscillator

Pins XTAL1 and XTAL2 of Atmega328 microcontroller are input and output, respectively. This crystal oscillator is a full swing oscillator, with rail-to-rail swing on the XTAL2 output. This is useful for driving other clock inputs and in noisy environments. Higher the clock frequency, higher the execution speed of controller. As 8-16Mhz crystals are best suited as per datasheet. Whereas C1 and C2 should always be equal for both crystals and resonators. The optimal value of the capacitors depends on the crystal or resonator in use, the amount of stray capacitance, and the electromagnetic noise of the environment. For ceramic resonators, the capacitor values given by the manufacturer should be used. For the frequency range of 8-16 MHz recommended range for capacitors C1 and C2 are 12 to 22pf. So here for 16Mhz crystal,22pf capacitors will be used.

Design Of Regulated Power Supply

The proper working of each and every component, the exact amount of voltage and current to be supplied to it. If the power exceed its limit, it can be fatal. If the supplyis lower than the required supply, some of the components will not function properly. The block diagram shows the steps during conversion of AC supply into regulated DCsupply.

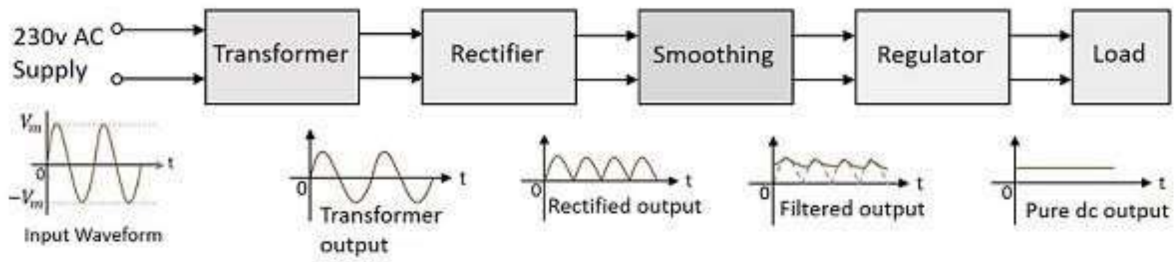


Figure 2: Block diagram of Power Supply

Design of Step Down Transformer

The following information must be available to the designer of the transformer.

1) Power output.
2) Operating voltage.
3) Frequency range.
4) Efficiency and regulation.

Size of core is one of the first consideration in regard of weight and volume of a transformer. This depends on type of core and winding configuration used. Generally following formula is used to find Area or Size of the Core.

$$Ai = \sqrt{Wp} / 0.87$$

Where Ai = Area of cross section in square cm.

Wp = Primary Wattage.

For our project we require +5V output, so transformer secondary winding ratingis 9V, 500mA. So secondary power wattage is,

$$P2 = 9 * 500mA$$

$$= 4.5Watt$$

So, $$Ai = \sqrt{4.5} / 0.87$$

$$= 2.4$$

Generally 10% of area should be added to the core.So,
Ai = 2.8
Now turns per volt: - Turns per volt of transformer are given by relation.Turns per volt = 100000 / 4.44 f * Bm * Ai

Where, F= Frequency in Hz.

Bm = Density in Wb / Square meter.
Ai = Net area of the cross section.

Following table gives the value of turns per volt for 50 Hz frequency. Generallylower the flux density better the quality of transformer. For our project we havetaken the turns per volt is 0.91 Wb / sq.m from above table.

Turns per volt = 50 / Ai

= 50 / 2.8

= 17.85

Thus the turns for the primary winding are,

220 * 17.85 = 3927

And for secondary winding, 9 * 17.85 = 160

Wire Size:- As stated above the size is depends upon the current to be carried out by winding which depends upon current density. For our transformer one tie can safely use current density of 3.1 Amp / sq.mm. For less copper loss 1.6Amp/sq.mm or 2.4sq.mm may be used generally even size gauge of wire are used. R.M.S secondary voltage at secondary to transformer is 9V.

So maximum voltage across secondary =Vm = 9 * 1.141

= 12.727v

D.C output voltage Vm across secondary is Vdc = 2 * Vm/pi

= 2 * 12.727/3.14

= 8.08 V

Selection of Diode For Rectifier

P.I.V rating of each diode is 2Vm

PIV = 2 * 8.08= 16.16 V

Maximum forward current, which flow from each diode is 500 mA. So fromabove parameter, we select diode 1N4007 with reverse voltage capacity of 1000V, forward current rating of 1Amp and 1.1 V voltage drop across it.

Selecting Filter Capacitor

Formula for calculating filter capacitor isC = ¼ √ 3 r * F * R1

Where,

R = ripple present at output of rectifier,

(which is maximum 0.1 for full wave rectifier)

F = frequency of AC main.

R1 = input impedance of voltage regulator IC

C = ¼ √ 3 * 0.1 * 50 * 28 = 1030 µf = 1000 µf

Voltage rating of filter capacitor should be greater than the i/p Vdc i.e. rectifier output which is 8.08 V so we choose 1000µf / 25V filter capacitor.

Selecting Voltage Regulator IC

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 Voltage Regulator, a member of 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates

the output voltage it provides. 7805 IC provides
+5 volts regulated power supply with provisions to add a heat sink.

Table 1: Specification of regulator IC

Parameter	LD1117	7805
DC output voltage.	+3.3V	+5V
Maximum Dropout Voltage	1.1V	2V
Vin maximum.	15V	25V
Output Current	1.3Amp	2Amp

There is a significant difference between the input voltage & the output voltage of the voltage regulator. This difference between the input and output voltage is released as heat. The greater the difference between the input and output voltage, more the heat generated. If the regulator does not have a heat sink to dissipate this heat, it can get destroyed and malfunction. Hence, it is advisable to limit the voltage to a maximumof 2-3 volts above the output voltage. So, we now have 2 options. Either design circuit so that the input voltage going into the regulator is limited to 2-3 volts above the outputregulated voltage or place an appropriate heatsink that can efficiently dissipate heat.

The below formula should help in determining appropriate heatsink size for suchapplications.

Heat generated = (input voltage – 5) x output current

If we have a system with input 15 volts and output current required is 0.5 amperes, wehave: (15 – 5) x 0.5 = 10×0.5 =5W;
5W energy is being wasted as heat, hence an appropriate heatsink is required to disperse this heat. On the other hand, energy actually being used is: (5 x 0.5Amp) = 2.5W. So twice the energy, that is actually utilized is wasted. On the other hand, if 9V is given asinput at the same amount of load: (9-5) x 0.5 = 2W. So here 2W energy will be wastedas heat.

Circuit Diagram

The whole design of the system is based mainly on IoT which is newly introduced concept in the world of development. There is basically two parts included, the first one is hardware & second one is software. The hardware part has sensors and other devices which helps to measure the real time values. Whereas software part includes webpage. In hardware atmega328 converts the analog values to digital one, &LCD shows the displays output from sensors, Wi-Fi module gives the connection between hardware and software. In hardware we developed a program based on embedded c language. The PCB is design at first level of construction and component and sensors mounted on it. The parameters are tested one but one and their result is given to the LCD display.

RESULTS

Expected Results

System will detect all parameters & calculate the possible threat as follows:Table 2: Expected Results

PIR Sensor output	Noise in compound wire	Compound wire break	Possible threat	Action to be taken
No	No	No	No	Normal
Detected	No	No	Animal/ theft	Mixed buzzer at start& alert if signal remains after 30 sec.
No	Detected	No	Animal/ theft	Mixed buzzer at start& alert if signal remains after 30 sec.
No	No	Detected	Theft	Loud Buzzer & Alert
Detected	Detected	XX	Theft	Loud Buzzer & Alert
Detected	XX	Detected	Theft	Loud Buzzer & Alert
XX	Detected	Detected	Theft	Loud Buzzer & Alert

- All readings will be uploaded to webpage continuously.
- In alert situation, alert signal will be displayed on webpage.
- In Mixed buzzer, buzzer beeps in high frequency & audible
- Frequencies alternate for 1 sec each

Conclusion

We believe that this project will help to farmers to secure crop fields. In this project by considering all the situations and possibility, we decided the specification for project and chosen components and sensors which are helping to achieve the desiretarget. Though, design of circuit is critical due to non-availability of some of module inProtius software. Whereas due to the use of Arduino development tools, reduce difficulties during programming & troubleshooting was reduced. Though all the designis ready, hardware part will start in next phase of project

Advantages

- No human help necessary in case of birds or animal intruder.
- Monitoring of crop field at compound and in inside area.
- Immediate IOT alert will be generated on detection of intruder.
- 24*7 monitoring and alert.

Applications

This project is useful for protection of crop-field from birds and animals as well as theft.

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