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# **Tech Bijuka: An Integrated Smart Agricultural System for Crop Protection and Irrigation Automation**

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**ABSTRACT:** Farmers in Dilod Hathi, Baran, Rajasthan face recurring crop losses due to wild animals and challenges in timely irrigation caused by irregular electricity supply. Traditional deterrent methods such as drums and Jhatka Machine are ineffective and impractical. To address these issues, a smart agricultural solution named **Tech Bijuka** is proposed. This integrated system combines an intelligent animal deterrent mechanism with automated electricity monitoring and alerting. The system periodically generates animal sounds, rotates directional LED lights during night, and sends real-time SMS notifications to farmers when electricity becomes available in the field. Powered by a solar panel and controlled through an Arduino-based architecture, the system ensures continuous, cost-effective, and farmer-friendly operation. Field validation demonstrated effective crop protection and timely irrigation support, establishing Tech Bijuka as a promising technological innovation for rural agricultural sustainability.

## **KEYWORDS**

Smart Agriculture, Animal Deterrent System, Irrigation Automation, Solar Powered System, GSM Alert System, Rural Innovation, Tech Bijuka

## **I. INTRODUCTION**

Agriculture remains the primary livelihood for rural communities, yet farmers encounter serious challenges affecting productivity and income. In Dilod Hathi village, two problems are particularly critical: (1) frequent destruction of crops by wild animals such as deer, blue bulls, and wild boars, and (2) uncertainty in irrigation due to irregular electricity supply. Farmers often stay awake late at night waiting for power availability, resulting in stress, time loss, and reduced agricultural efficiency.

Existing animal deterrent methods such as fences, sound drums, and Jhatka Machine are either harmful, costly, or ineffective over time. Similarly, manual monitoring of electricity is impractical and reduces farmer productivity. Therefore, a sustainable, automated, and farmer-friendly technological solution is required.

Tech Bijuka is designed as an integrated system to address both challenges simultaneously. The device scares animals away using sound and rotating light patterns, while also notifying farmers about electricity availability via SMS. The system is solar powered, making it independent of grid electricity and suitable for rural environments.



## II. SYSTEM DESIGN

The Tech Bijuka system consists of:

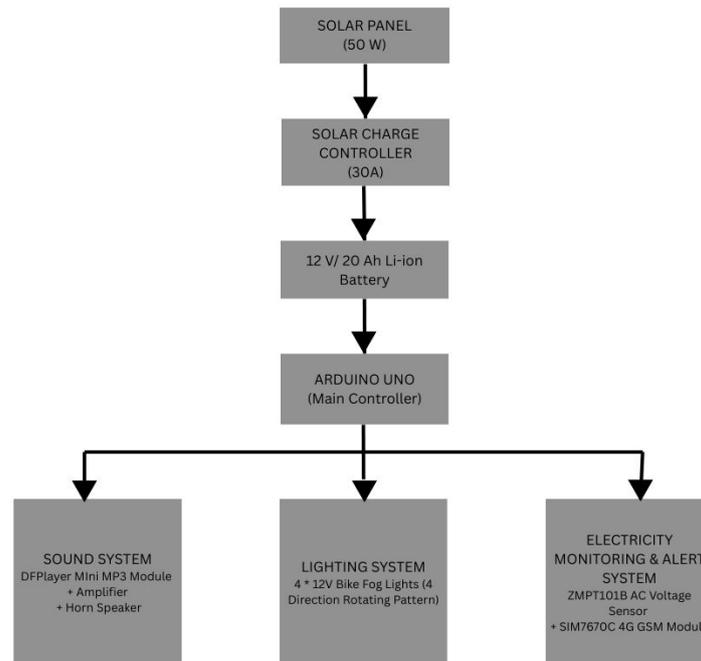
- **Animal Deterrent Unit**
  - DFPlayer Mini MP3 Module for sound playback
  - Amplifier and horn speakers to produce loud animal-like sounds
  - Four directional LED fog lights producing rotating illumination
- **Electricity Monitoring and Alert Unit**
  - ZMPT101B AC voltage sensor to detect grid electricity
  - SIM7670C 4G GSM module to send SMS alerts
  - Arduino UNO as the main controller
- **Power Management Unit**
  - 50W solar panel
  - 12V 20Ah Lithium-ion battery
  - 30A solar charge controller

The system operates through two switches:

Switch-1 activates the animal deterrent mechanism, while Switch-2 enables electricity monitoring and SMS alert functionality.



### III. BLOCK DIAGRAM



### IV. METHODOLOGY

#### 1. System Activation

Farmers turn on Switch-1 to activate animal deterrent mode and Switch-2 to enable electricity monitoring.

#### 2. Sound Mechanism

Pre-recorded threatening animal sounds are stored in DFPlayer Mini. Arduino triggers playback every 15 minutes. Sound is amplified using TPA3116D2 and broadcast via horn speakers.

#### 3. Rotating Light Mechanism

Four LED fog lights are installed in four directions. At night, one light glows brightly for one minute while others remain dim. Brightness rotates sequentially, creating movement illusion to scare animals.

#### 4. Electricity Detection and Alert

ZMPT101B continuously senses AC supply. When grid electricity is detected, SIM7670C sends SMS stating "Electricity ON". When absent, it sends "Electricity OFF".

#### 5. Power Supply

Solar panel charges battery during daytime. Stored energy powers components continuously ensuring reliability.

### V. SOFTWARE IMPLEMENTATION

Programmed using the Arduino IDE:

```
#include <SoftwareSerial.h>
#include <DFRobotDFPlayerMini.h>
```

```
/* ----- PIN DEFINITIONS ----- */
const int relayPins[4] = {4, 5, 6, 7}; // 4-channel relay
const int zmptPin = A0; // AC Voltage Sensor
```

```
// DFPlayer Mini
SoftwareSerial dfSerial(10, 11);    // RX, TX
DFRobotDFPlayerMini dfPlayer;

// SIM7670C GSM
SoftwareSerial gsmSerial(2, 3);    // RX, TX

/* ----- VARIABLES ----- */
unsigned long previousMillis = 0;
const unsigned long interval = 60000; // 1 minute
int currentRelay = 0;

bool electricityState = false;
bool lastElectricityState = false;

/* ----- SETUP ----- */
void setup() {
  Serial.begin(9600);

  // Relay setup
  for (int i = 0; i < 4; i++) {
    pinMode(relayPins[i], OUTPUT);
    digitalWrite(relayPins[i], HIGH); // OFF (LOW-level trigger)
  }

  // DFPlayer setup
  dfSerial.begin(9600);
  if (dfPlayer.begin(dfSerial)) {
    dfPlayer.volume(25); // Volume (0-30)
    dfPlayer.play(1);    // Play 0001.mp3
  }

  // GSM setup
  gsmSerial.begin(9600);
  delay(2000);
  sendAT("AT");
  sendAT("AT+CMGF=1"); // Text mode SMS
}

/* ----- LOOP ----- */
void loop() {
  relaySequence();
  checkACVoltage();
}

/* ----- TASK 1: RELAY LED SEQUENCE ----- */
void relaySequence() {
  unsigned long currentMillis = millis();

  if (currentMillis - previousMillis >= interval) {
    previousMillis = currentMillis;

    // Turn OFF all relays
    for (int i = 0; i < 4; i++) {
```

```
digitalWrite(relayPins[i], HIGH);
}

// Turn ON current relay
digitalWrite(relayPins[currentRelay], LOW);

// Move to next relay
currentRelay++;
if (currentRelay >= 4) {
    currentRelay = 0;
}
}
}

/* ----- TASK 3: AC VOLTAGE + SMS ----- */
void checkACVoltage() {
    int sensorValue = analogRead(zmptPin);

    // Adjust threshold based on calibration
    if (sensorValue > 100) {
        electricityState = true;
    } else {
        electricityState = false;
    }

    // Send SMS only on state change
    if (electricityState != lastElectricityState) {
        if (electricityState) {
            sendSMS("Electricity ON");
        } else {
            sendSMS("Electricity OFF");
        }
        lastElectricityState = electricityState;
    }

    delay(500);
}

/* ----- GSM FUNCTIONS ----- */
void sendSMS(String message) {
    gsmSerial.println("AT+CMGS="+91XXXXXXXXXX\"); // Replace number
    delay(1000);
    gsmSerial.print(message);
    delay(500);
    gsmSerial.write(26); // CTRL+Z
    delay(3000);
}

void sendAT(String cmd) {
    gsmSerial.println(cmd);
    delay(1000);
}
```

## VI. RESULT

Field testing was conducted in Dilod Hathi village farms. Observations included:

- Significant reduction in animal intrusion in test fields.
- Farmers reported less crop damage during night.
- Timely SMS alerts enabled farmers to start irrigation immediately once electricity became available.
- Solar-powered operation ensured uninterrupted functionality.
- System was user-friendly, cost-effective, and highly practical for rural farmers.

## VII. DISCUSSION

Tech Bijuka addresses two critical agricultural challenges using an integrated, sustainable approach. Unlike harmful fencing or electric shock systems, this solution is safe for both animals and farmers. The rotating light mechanism reduces habituation effect, keeping animals effectively away. GSM-based alerting greatly improves farmer convenience and time management.

However, sound repetition intervals may need customization based on crop type and animal behavior. Network dependency may affect SMS performance in weak signal areas. Future versions may integrate water pump auto-start capability, IoT dashboard, camera-based animal detection, and AI-based smart automation.

## VIII. CONCLUSION

The Tech Bijuka system successfully demonstrates an innovative technological intervention for rural agriculture. By combining crop protection and irrigation alerting in a single solar-powered solution, the system enhances productivity, reduces farmer stress, and supports sustainable farming practices. It presents a scalable and replicable model for rural agricultural innovation across India and similar regions.

## IX. ACKNOWLEDGEMENT

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