Design and Implementation of an Intelligent Animal Intrusion Detection System for Farm Protection from Wild Animals using Internet of Things

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MATLAB EXPO 2018
Brief Introduction

- Higher Demand in Food Production
- People and Animal Conflicts
- Harmful for the Animals
- Destruction of Crops and Farm Infrastructure
- Wireless sensor Networks
- Internet of Things
Problem statement

- Loss of Human Life and Injury to Human Beings
- Harmful for Animals
- Needs,
  - Sensing
  - Reporting
  - Preliminary Prevention Actions
  - Automated Manner
  - More Cost Effective
Crop Damages

<table>
<thead>
<tr>
<th>Animal causing the damage</th>
<th>Crop damaged</th>
<th>Percentage crop damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wild Boar</td>
<td>Cereals (maize, wheat, oats, Barley)</td>
<td>46.48</td>
</tr>
<tr>
<td></td>
<td>Vineyards</td>
<td>13.71</td>
</tr>
<tr>
<td></td>
<td>Durum wheat</td>
<td>13.84</td>
</tr>
<tr>
<td></td>
<td>Hazelnuts</td>
<td>12.92</td>
</tr>
<tr>
<td></td>
<td>Grassland</td>
<td>11.62</td>
</tr>
<tr>
<td></td>
<td>Sunflower</td>
<td>8.62</td>
</tr>
<tr>
<td></td>
<td>Chestnuts</td>
<td>3.26</td>
</tr>
<tr>
<td>Monkeys, Porcupine, Goral, Deer, Bear</td>
<td>Maize</td>
<td>38.90</td>
</tr>
<tr>
<td></td>
<td>Potato</td>
<td>29.60</td>
</tr>
<tr>
<td></td>
<td>Millet</td>
<td>18.60</td>
</tr>
<tr>
<td></td>
<td>Wheat</td>
<td>6.70</td>
</tr>
<tr>
<td></td>
<td>Paddy</td>
<td>3.80</td>
</tr>
<tr>
<td></td>
<td>Pulses</td>
<td>0.23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Wild animal</th>
<th>Crops</th>
<th>Percentage crop damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elephant</td>
<td>Coconut, plantain, paddy</td>
<td>72</td>
</tr>
<tr>
<td>Gaur</td>
<td>Mulberry, sandal</td>
<td>62</td>
</tr>
<tr>
<td>Sambar</td>
<td>White sapota</td>
<td>17</td>
</tr>
<tr>
<td>Wild boar</td>
<td>Tapioca, tubers, paddy</td>
<td>16</td>
</tr>
</tbody>
</table>

Italy and Nepal

Kerala (India)
Issues and Challenges

• **Issues:**
  - Scare-Crow, Hellikites, Balloons, Flyers, Shot/Gas guns, String & stone, etc.
  - Nylon nets and Fencing

• **Challenges:**
  - Animal classification, detection and tracking their positions.
  - Sensors and Cameras.
Approach

- Internet of Things
- Sensing: Detection of entry of the animal in the crop field
- Communicating and taking preliminary actions
- Divert Animals
- Maintaining ecological balance
Tools used

- Matlab 2016b
- Raspberry Pi b+
- Arduino Uno
- PIR Sensor
- Ultrasonic Sensor
- Wi-fi Shield for Arduino
- Camera
Experimental Setup

- **Sensing Unit**
  - Passive infrared Sensor (PIR)
  - Ultrasonic Sensor

- **Control Unit**
  - Monitoring
  - Primary action tacking
  - Send notifications to caretaker

- **User Interface**

- **Recording Unit**
  - Camera
  - Database
Sensors

Ultrasonic
Control

Sensing Node → Camera

Sensing Node → Ultrasonic

Sensing Node → PIR

Sensing Node → Storage

User Interface → Raspberry Pi

Server Node
Record

Camera

Sensors -> Arduino

Arduino -> Server

Server -> Database

Monitor
User Interface

- Server: Disconnected
- Node 1: Connected
- Node 2: Disconnected
- Node 3: Disconnected
- Node 4: Disconnected

Graph showing data over time with metrics for latency, average, minimum, maximum, and duration.
Features

- Cost effective
- Robustness
- Reliable
- Easily adaptable by the farmers
- Remote Monitor
- Low energy consumption
Result

- Implemented the prototype in Trichy (Tamil Nada, India)
- Powered by solar power source
- More than 92% accuracy
- Less Implementation Cost
- Predicted monkeys and goats
- Recorded the status using cameras
Conclusion

- Field tested the prototype at Trichy (Tamil Nadu, India).
- Installed easily and cost effective
- Ecological balance
- Less power requirement
- Solar panel based charging unit is provided
- Audio signal patterns
- Alert message
References

Thank You