AI and IOT based Animal Recognition and Repelling System for Smart Farming

Ms.K.PREMKUMAR. M.E., Assistant Professor, Department of Computer Science and Engineering

Ms.P.MADASAMY, B.E, Student of Computer Science Engineering

Ms.T.DHINA, B.E, Student of Computer science and Engineering St. Joseph College of Engineering, Sriperumbudur, Chennai.

ABSTRACT

Agriculture automation has been on the rise leveraging, among others, Deep Neural Networks (DNN) and IoT for the development and deployment of many controlling, monitoring and tracking applications at a fine-grained level. In this rapidly evolving scenario, managing the relationship with the elements external to the agriculture ecosystem, such as wildlife, is a relevant open issue. One of the main concerns of today's farmers is protecting crops from wild animals' attacks.

There are different traditional approaches to address this problem which can be lethal (e.g., shooting, trapping) and non-lethal (e.g., scarecrow, chemical repellents, organic substances, mesh, or electric fences). Nevertheless some of the traditional methods have environmental pollution effects on both humans and ungulates, while others arevery expensive with high maintenance costs, with limited reliability and limited effectiveness. In this project, we develop a system that combines AI Computer Vision using DCNN for detecting and recognizing animal species, and specific ultrasound emission (i.e., different for each species) for repelling them.

The edge computing device activates the camera, then executes its DCNN software to identify the target, and if an animal is detected, it sends back a message to the Animal Repelling Module including the type of ultrasound to be generated according to the category of the animal.

INTRODUCTION

Agriculture has seen many revolutions, whether the domestication of animals and plants a few thousand years ago, the systematic use of crop rotations and other improvements in farming practice a few hundred years ago, or the "green revolution" with systematic breeding and the widespread use of man-made fertilizers and pesticides a few decades ago.

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Moreover, decision-tree models are available now that allow farmers to differentiate between plant diseases based on optical information. Virtual fence technologies allow cattle herd management based on remote-sensing signals and sensors or actuators attached to the livestock.

LITERATURE SURVEY

The use of passive acoustic monitoring in wildlife ecology has increased dramatically in recent years as researchers take advantage of improvements in autonomous recording units and analytical methods. These technologies have allowed researchers to collect large quantities of acoustic data which must then be processed to extract meaningful information, e.g., target species detections.

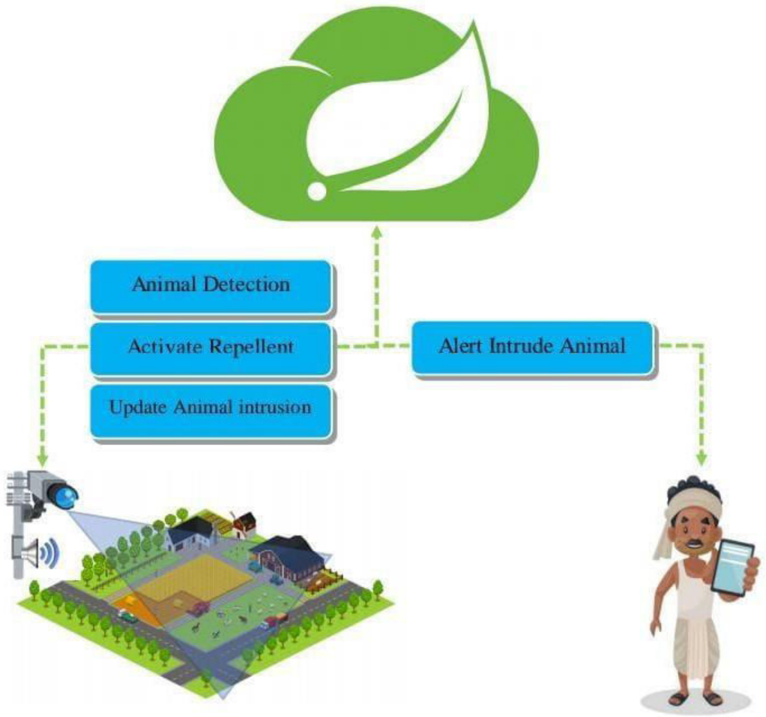
This article reports on the development and application of a deep convolutional neural network for the automated detection of 14 forest-adapted birds and mammals by classifying spectrogram images generated from short audio clips.

This workflow reduces the necessary human effort by > 99% compared to full manual review of the data. As an optional component of this workflow, this article proposed a graphical interface for the neural network that can be run through RStudio using the Shiny package, creating a portable and user-friendly way for field biologists and managers to efficiently process audio data and detect these target species close to the point of collection and with minimal delays using consumer-grade computers.

SYSTEM DESIGN

In this phase of methodology, testing was carried out on the several application modules. Different kind of testing was done on the modules which are described in the following sections. Generally, tests were done against functional and non-functional requirements of the application following the test cases. Testing the application again and again helped it to become a reliable and stable system.

Hey are more accurate than the models trained from scratch, especially for the species that have a similar color. This is because the pretrained models can already extract the low-level features of a new image. Another advantage of the models trained by transfer learning is that the model does not need to draw a bounding box to train the last layer.

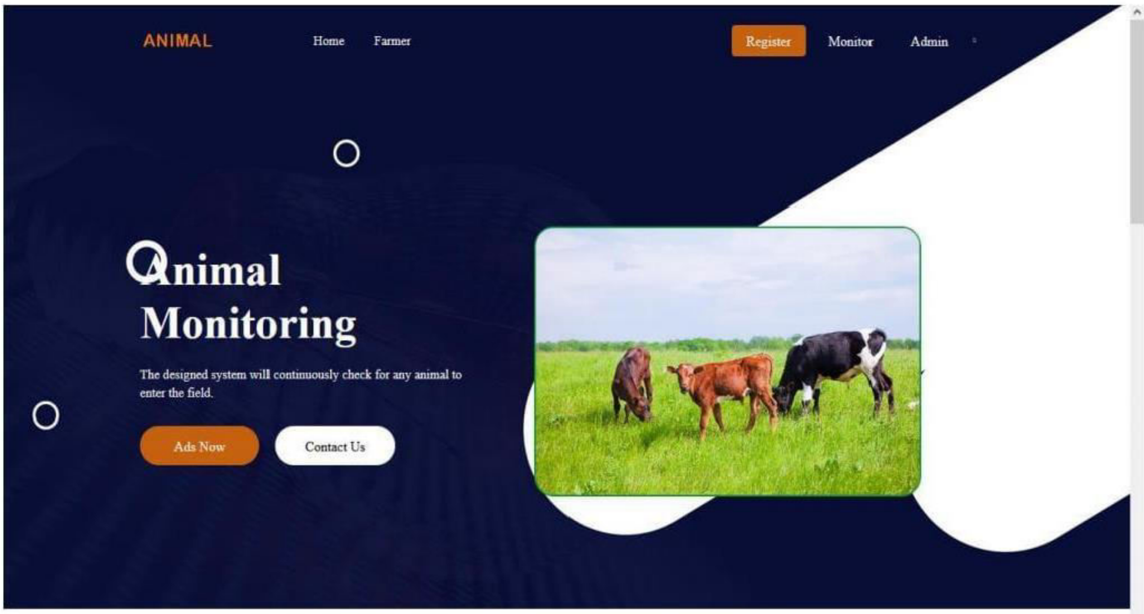


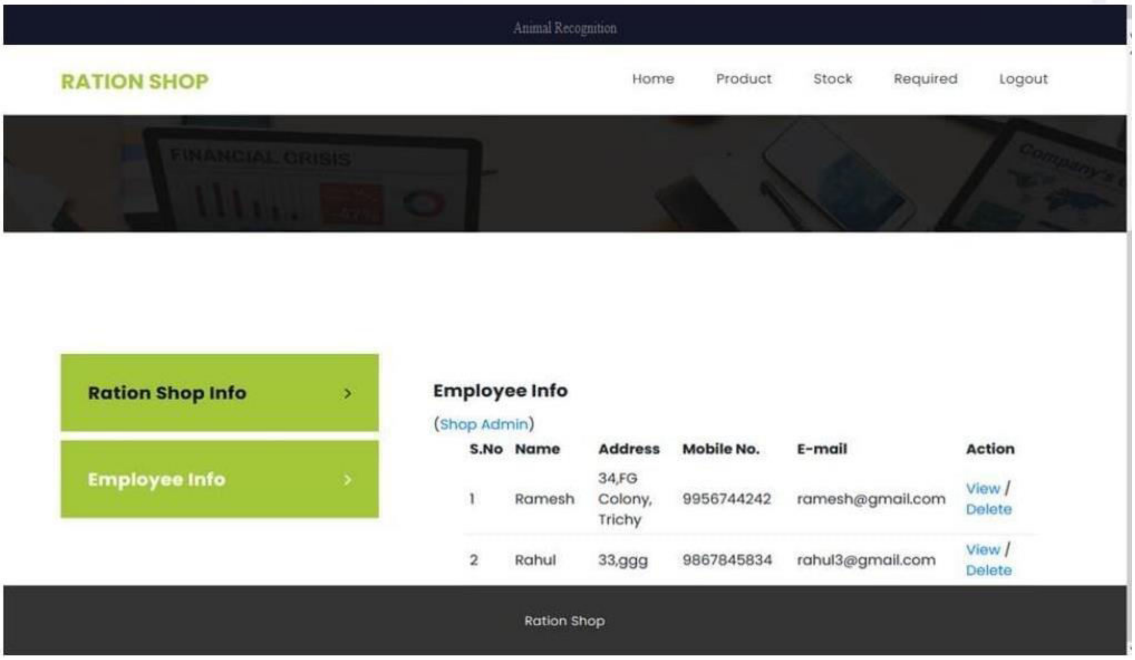
This approach will greatly reduce the inconvenience for humans by eliminating manual processes. We expect that the accuracy will be increased if fine tuning is applied. Finally, Tf.keras-based model can be easily deployed on an Android mobile device using the FlatBuffer file converter provided by TensorFlow Lite. To clarify the key points of this study, we suggest the following highlights:

(i) CNN models with transfer learning can be trained without any special difficulty

(ii) The designed advanced CNN models do not require any manual preprocessing (such as labeling or drawing bounding boxes on the images).

SNAPSHOTS





CONCLUSION

Agricultural farm security is widely needed technology nowadays. In order to accomplish this, a vision-based system is proposed and implemented using Python and OpenCV and developedanAnimal Repellent System to blow out the animals.The implementationof the application required the design and development of acomplex system for intelligent animal repulsion, which integratesnewly developed software components and allows to recognize the presence and species of animals in realtime and also to avoid crop damages caused by the animals.

FUTURE ENHANCEMENT

Further in the proposed architecture, some image compression techniques can be developed to reduce the time taken for notification to reach user as described above.

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AUTHOR 1

Mr.K.PRAVEENKUMAR.,M.E., Assistant Professor,Department of Computer Science and Engineering at St.Joseph College of Engineering, Sriperumbudur, Chennai, TamilNadu.

AUTHOR 2

Mr.T.DHINA B.E., Student of Computer Science and Engineering at St.Joseph College of Engineering, Sriperumbudur, Chennai, TamilNadu. I had attended many Workshops, Seminars in py

AUTHOR 3

Mr.P.MADASAMY B.E., Student of Computer Science and Engineering at St.Joseph College of Engineering, Sriperumbudur, Chennai, TamilNadu. I had attended many Workshops, Seminars in python.