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Monitoring of Pet Animal in Smart Cities using Animal Biometrics

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Abstract

Monitoring of pet animal in smart city is a big challenge for authorities concerned. The classical animal identification and monitoring methods fail to provide the required level of security and management of pet animals. Animal biometrics based recognition systems are considered a good alternative for the health management, tracking, identification, and security of pet animals. In this paper, we propose a low-cost system for monitoring of pet animals (dogs) based on their primary animal biometric identifiers. The proposed recognition approach uses the one-shot similarity and distance metric based learning methods for matching and classifying the extracted features of face images for recognition of pet animals (dog). We also developed a prototype for evaluating the accuracy of the recognition system. The efficacy of proposed pet animal recognition system is evaluated under identification settings yields 96.87% recognition rate.

Keywords: Animal biometrics, Pet animal, Face recognition, Smart city, Security, Monitoring, Dog, OSS, FLPP, LBP, SURF, LDA

1. Introduction

Smart cities include various kinds of intelligent devices with efficient functions and systems [1], that can be accessed remotely by the users [2]. The main objective of the smart city is to provide an enhanced comfort, saving of resources, efficient retrieval of information, fast communication, better security for its residents and pet animals [2, 3].

According to available literature, the total population of pets (dogs) in the throughout wold is more than 700 million [4], and 7 million dogs enter the animal shelters in the United States every year. Only 10% of the total population of pets are adopted or make it back to their owners or parentage in the smart cities[5].

According to reference [6], in the USA, there is one pet animal for every three humans, and the increasing rate of domestic animals (i.e., canine breeds), and other pets ownership keeps rising continuously. Based on the current report of pet animals in 2015-16, the total number of pets is about $153,000$ (especially dogs) in the city of Seattle which is greater than the number of children of each family *(e.g.,* $107,000$ *children)*.

Similarly, New York City also recorded a rapid increase in the number of production of dog breeds, and in owners of pet animals *(e.g.,* $600,000$ *dogs)* which is greater than the previous year [7]. It is a huge problem in the monitoring and recognition of huge population of pet animals using existing approaches and traditional identification systems in the smart cities of the United States.

In a similar direction, author Maroto [7] reported that more than $50,000$ starving stray pet animals (dogs) swarmed Detroit when the pets owners left the bankrupt city leaving their pet animals behind. Based on the current survey of pet animals, the average number of pets per household varies in different countries, generally depending on the total population.

Still, there is no record, database or any documentation available for the average number of pet animals per household in the smart cities throughout the world. However, the U.K. have an average of 3.7 pet animals, in contrast to the USA states, which have an average of 3.9 [8]. The values depict more than 4 billion pet animals are living with people [8]. Further, in the U.K. nearly 4 million dogs and around 3 million cat owners take their pet animals away, when enjoying a short break, or attending a different kind of conferences for business away from their home or city [8, 9].

The recognition and monitoring of the huge population of pet animals (e.g., dogs and other pet animals) are major problems in the smart cities throughout the world [7, 10, 11]. For the recognition of missed, or swapped of pet animals, monitoring and verification of false insurance claims, no animal biometric recognition systems are found in the literature or public domains to solve these major challenging problems of pet animals [7]. These major problems cannot be neglected by computer vision scientists, professionals, animal experts, and different research communities to provide to the consistent efforts for the design, and development of a non-invasive, cost-effective and automatic system for the monitoring of pet animals.

Due to the failure of the traditional animal recognition systems for solving the major challenging problems of pets, there is a requirement to develop an animal biometrics based recognition system for pet animal to recognize and monitoring of individual pet animals in the smart cities.

The pet animal recognition system can help to identify the

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