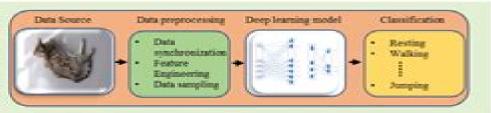


# A Deep Learning Approach for Detecting and Classifying Cat Activity to Monitor and Improve Cat's Well-being using Accelerometer, Gyroscope, and Magnetometer

Ali Hussain\*, Sikandar Ali\*, Moon-II Joo, and Hee Cheol Kim

Abstract—Activity detection of pets using sensor technology and Artificial Intelligence (AI) approaches has gained momentum in recent years. These technologies have revamped up the monitoring systems for the well-being of pets and are emerging as revolutionary technologies. Most of the research works have been conducted on the activity detection of humans, dogs, sheep, and horses; however, cat activity detection has not been explored meticulously using the



aforementioned latest technologies. In this research, we proposed an LSTM-based deep learning model and investigated the activity detection of cats using three wearable sensors. Our research content can be summarized as follows. First, we collected 1,765,825 data samples from 10 cats of different ages, breeds, and gender using an accelerometer, gyroscope, and magnetometer. Second, the raw data were preprocessed by applying data transformation approaches and feature engineering techniques. Third, we developed three different kinds of deep learning models, namely; ANN, 1D-CNN, and LSTM, to classify ten different activities of cats. Hyperparameter tuning was performed to optimize the performance of the models. LSTM model outperformed other models and showed good accuracy. The model achieved an accuracy of 95.94%. To the best of our knowledge, this work is the first of its kind, which applied a deep learning-based model for the detection of cat activity using three kinds of sensor data such as accelerometer, gyroscope, and magnetometer. This proposed model will help improve the well-being of cats by detecting the activities of cats with high accuracy using wearable sensor devices and deep learning technology.

Index Terms—Cat activity detection, pet activity detection, LSTM, wearable sensors, deep learning, sensor data, accelerometer, gyroscope, magnetometer,

#### I. INTRODUCTION

Recently, human and pet activity recognition has drawn much attention for monitoring and tracking of their activities, which helps to understand behavioral changes, thus

This research was supported by the MSIT(Ministry of Science ICT), Korea, under the National Program for Excellence in SW, supervised by the IITP(Institute of Information & Communications Technology Planning & Evaluation) in 2022 (2022-0-01091, 1711175863).

All Hussain, Sikandar All, are with the Institute of Digital Anti-Aging Healthcare, Inje University, Gimhae 50634. South Korea. (e-mail: allhussain4541@live.ine.ac.kr.allhussainnrana@gmail.com.sikandarali.@live.inje.ac.kr).

†: These authors contributed equally.

Moon-II Joo is a research professor with the Institute of Digital Anti-Aging Healthcare, Inje University, Gimhae 50834, South Korea. (email: joomi@linje.ac.kr)

Hee Cheol Kim with the College of Al Convergence, Institute of Digital Anti-Aging Healthcare, u-AHRC, Inje University, Gimhae 50834, South Korea. As a full professor. (Corresponding author e-mail: heeki@inje.ac.kr) improving their overall health and well-being [1-4]. The behavioral changes and activity patterns of humans and animals can be monitored using digital information processing technologies, which include wearable sensor technology, video recording devices, artificial intelligence-based models, etc. [5-11]. These technologies help us to monitor and track the physical movement and body postures of animals with high precision. In the past, the activities and behaviors of pets were used to be monitored by human observers, which was not a good approach because it interferes with the normal life of pets; thus, the actual behavior could not be observed or captured.

Newadays, wearable sensor technology is being used for collecting activity data from pets. Wearable sensor technology enables continuous sensing of the daily activities of pets without interrupting their normal daily life behavior. These wearable sensors are attached to the body of the pet, and data is continuously generated and collected without any external interference. Activity data collected through wearable sensor

## **Classifying Cat**

**Francois Chollet, Matthew Watson** 

#### **Classifying Cat:**

The Cat, a Guide to the Classification and Varieties of Cats and a Short Tratise Upon Their Care, Diseases, and Treatment Rush Shippen Huidekoper, 1895 PREFACE THE Author of this very practical treatise on Scotch Loch Fishing desires clearly that it may be of use to all who had it He does not pretend to have written anything new but to have attempted to put what he has to say in as readable a form as possible Everything in the way of the history and habits of fish has been studiously avoided and technicalities have been used as sparingly as possible. The writing of this book has afforded him pleasure in his leisure moments and that pleasure would be much increased if he knew that the perusal of it would create any bond of sympathy between himself and the angling community in general This section is interleaved with blank shects for the readers notes The Author need hardly say that any suggestions addressed to the case of the publishers will meet with consideration in a future edition We do not pretend to write or enlarge upon a new subject Much has been said and written and well said and written too on the art of fishing but loch fishing has been rather looked upon as a second rate performance and to dispel this idea is one of the objects for which this present treatise has been written Far be it from us to say anything against fishing lawfully practised in any form but many pent up in our large towns will bear us out when me say that on the whole a days loch fishing is the most convenient One great matter is that the loch fisher is depend ent on nothing but enough wind to curl the water and on a large loch it is very seldom that a dead calm prevails all day and can make his arrangements for a day weeks beforehand whereas the stream fisher is dependent for a good take on the state of the water and however pleasant and easy it may be for one living near the banks of a good trout stream or river it is guite another matter to arrange for a days river fishing if one is looking forward to a holiday at a date some weeks ahead Providence may favour the expectant angler with a good day and the water in order but experience has taught most of us that the good days are in the minority and that as is the case with our rapid running streams such as many of our northern streams are the water is either too large or too small unless as previously remarked you live near at hand and can catch it at its best A common belief in regard to loch fishing is that the tyro and the experienced angler have nearly the same chance in fishing the one from the stern and the other from the bow of the same boat Of all the absurd beliefs as to loch fishing this is one of the most absurd Try it Give the tyro either end of the boat he likes give him a cast of ally flies he may fancy or even a cast similar to those which a crack may be using and if he catches one for every three the other has he may consider himself very lucky Of course there are lochs where the fish are not abundant and a beginner may come across as many as an older fisher but we speak of lochs where there are fish to be caught and where each has a fair chance Again it is said that the boatman has as much to do with catching trout in a loch as the angler Well we dont deny that In an untried loch it is necessary to have the guidance of a good boatman but the same argument holds good as to stream fishing **The Domestic Cat** Dennis C. Turner, Patrick Bateson, 2014 Experts from a range of fields provide the latest authoritative accounts of domestic cat behaviour and their

interaction with humans Classification Clues N.Geographic, 2009 **Animal Classification** Eve Hartman, Wendy Meshbesher, 2015-01-29 This engaging book about cats teaches readers about animal classification The Topological Classification of Stratified Spaces Shmuel Weinberger, 1994 This book provides the theory for stratified spaces along with important examples and applications that is analogous to the surgery theory for manifolds In the first expository account of this field Weinberger provides topologists with a new way of looking at the classification theory of singular spaces with his original results Divided into three parts the book begins with an overview of modern high dimensional manifold theory Rather than including complete proofs of all theorems Weinberger demonstrates key constructions gives convenient formulations and shows the usefulness of the technology Part II offers the parallel theory for stratified spaces Here the topological category is most completely developed using the methods of controlled topology Many examples illustrating the topological invariance and noninvariance of obstructions and characteristic classes are provided Applications for embeddings and immersions of manifolds for the geometry of group actions for algebraic varieties and for rigidity theorems are found in Part III This volume will be of interest to topologists as well as mathematicians in other fields such as differential geometry operator theory and algebraic geometry Exploring the Classification of Living Things Ella Hawley, 2012-08-15 Explains how scientists classify living organisms how the science of classification has changed over time how the natural world continues to evolve and where everyday living things fit into the classification system The Encyclopedia of Animals ,2004 This lavishly illustrated trade reference to mammals birds reptiles amphibians fishes and invertebrates features hundreds of glorious photos masterful illustrations and informative maps **Deep Learning with R, Second Edition** Francois Chollet, Tomasz Kalinowski, J. J. Allaire, 2022-07-26 Deep Learning with R Second Edition shows you how to put deep learning into action It's based on the revised new edition of Fran ois Chollet's bestselling Deep Learning with Python All code and examples have been expertly translated to the R language by Tomasz Kalinowski who maintains the Keras and Tensorflow R packages at RStudio Novices and experienced ML practitioners will love the expert insights practical techniques and important theory for building neural networks **Animal Classification** Eve Hartman, Wendy Meshbesher, 2014 What are vertebrates Which primate can fit in the palm of your hand What do a cat and a fish have in common In this book readers are introduced to Fluffy the cat Learning about Fluffy's family tree helps them to discover how different animals are grouped and classified Each book in this series provides superb coverage of a science topic with an interesting twist An exciting real life application makes the topic fun accessible and shows readers why science matters Deep Learning with Python, Third **Edition** Francois Chollet, Matthew Watson, 2025-09-30 The bestselling book on Python deep learning now covering generative AI Keras 3 PyTorch and JAX Deep Learning with Python Third Edition puts the power of deep learning in your hands This new edition includes the latest Keras and TensorFlow features generative AI models and added coverage of PyTorch and JAX Learn directly from the creator of Keras and step confidently into the world of deep learning with Python In

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example in a multiple cut off procedure that requires mastery on at least a certain subset of skills The number of DCMs discussed in the literature and applied to a variety of assessment data has been increasing over the past decades and their appeal to researchers and practitioners alike continues to grow These models have been used in English language assessment international large scale assessments and for feedback for practice exams in preparation of college admission testing just to name a few Nowadays technology based assessments provide increasingly rich data on a multitude of skills and allow collection of data with respect to multiple types of behaviors Diagnostic models can be understood as an ideal match for these types of data collections to provide more in depth information about test taker skills and behavioral Foundational Essays on Topological Manifolds, Smoothings, and Triangulations. (AM-88), Volume tendencies 88 Robion C. Kirby, Laurence C. Siebenmann, 2016-03-02 Since Poincar's time topologists have been most concerned with three species of manifold The most primitive of these the TOP manifolds remained rather mysterious until 1968 when Kirby discovered his now famous torus unfurling device A period of rapid progress with TOP manifolds ensued including in 1969 Siebenmann's refutation of the Hauptvermutung and the Triangulation Conjecture Here is the first connected account of Kirby's and Siebenmann's basic research in this area. The five sections of this book are introduced by three articles by the authors that initially appeared between 1968 and 1970 Appendices provide a full discussion of the classification of homotopy tori including Casson's unpublished work and a consideration of periodicity in topological surgery Deep Learning with Python, Second Edition François Chollet, François Chollet, 2021-12-21 Deep Learning with Python introduces the field of deep learning using the Python language and the powerful Keras library You ll learn directly from the creator of Keras Fran ois Chollet building your understanding through intuitive explanations and practical examples Updated from the original bestseller with over 50% new content this second edition includes new chapters cutting edge innovations and coverage of the very latest deep learning tools You ll explore challenging concepts and practice with applications in computer vision natural language processing and generative models By the time you finish you ll have the knowledge and hands on skills to apply deep learning in your own projects **Essential Classification** Vanda Broughton, 2015-07-01 Classification is a crucial skill for all information workers involved in organizing collections This new edition offers fully revised and updated guidance on how to go about classifying a document from scratch Essential Classification leads the novice classifier step by step through the basics of subject cataloguing with an emphasis on practical document analysis and classification It deals with fundamental questions of the purpose of classification in different situations and the needs and expectations of end users The reader is introduced to the ways in which document content can be assessed and how this can best be expressed for translation into the language of specific indexing and classification systems Fully updated to reflect changes to the major general schemes Library of Congress LCSH Dewey and UDC since the first edition and with new chapters on working with informal classification from folksonomies to tagging and social media this new edition will set cataloguers on the right path

Key areas covered are The need for classification The variety of classification The structure of classification Working with informal classification Management aspects of classification Classification in digital space This guide is essential reading for library school students novice cataloguers and all information workers who need to classify but have not formally been taught how It also offers practical guidance to computer scientists internet and intranet managers and all others concerned with the design and maintenance of subject tools Feline Orthopaedics Harry Scott, Juan M. Marti, Philip Witte, 2022-05-12 Cats are not referred to specialists as frequently as dogs meaning the general practitioner must routinely treat cats that have been involved in road traffic accidents and other musculoskeletal trauma This book is the first of its kind to provide a practical and user friendly guide to feline orthopaedics With a new author team led by RCVS Specialist in Small Animal Surgery Orthopaedics and Veterinary Neurology Harry Scott the second edition has been thoroughly revised and updated New chapters cover Physiotherapy and Oncology of the Feline Skeletal System The book includes highly structured fully referenced text that provides a concise straightforward guide to the recognition and management of specific diseases and conditions In this new edition the neurological causes of lameness have been given more in depth discussion with an emphasis on early recognition of clinical signs and diagnosis The disorder sections are now divided into those likely to be associated with trauma fractures and luxation and those which are congenital or developmental. The text is supported by high quality radiographs colour photographs and colour line drawings to illustrate principles techniques and procedures Combining their experience in practice and education the authors have produced a book that appeals to general practice veterinarians specialist feline practitioners and to students **Integration of Modern Taxonomic Methods For** Penicillium and Aspergillus Classification Robert A. Samson, J I Pitt, 2003-09-02 Many species of penicillium and aspergillus are important in biotechnology food medicine biodeterioration and other applied fields so a practical and stable taxonomy is of vital importance Recent developments in science and technology mean that taxonomic classification is no longer confined to classical morphological concepts and the integrat Computerized Adaptive Testing David J. Weiss, Alper Sahin, 2024-04-29 Used worldwide in assessment and professional certification contexts computerized adaptive testing CAT offers a powerful means to measure individual differences or make classifications This authoritative work from CAT pioneer David J Weiss and Alper ahin provides a complete how to guide for planning and implementing an effective CAT to create a test unique to each person in real time The book reviews the history of CAT and the basics of item response theory used in CAT It walks the reader through developing an item bank pretesting and linking items selecting required CAT options and using simulations to design a CAT Available software for CAT delivery is described including links to free and commercial options Engaging multidisciplinary examples illustrate applications of CAT for measuring ability achievement proficiency personality attitudes perceptions patients reports of their symptoms and academic or clinical progress **OECD** Guidelines for the Testing of Chemicals, Section 4 Test No. 491: Short Time Exposure In Vitro Test Method for Identifying i) Chemicals

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#### **Table of Contents Classifying Cat**

- 1. Understanding the eBook Classifying Cat
  - The Rise of Digital Reading Classifying Cat
  - Advantages of eBooks Over Traditional Books
- 2. Identifying Classifying Cat
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
- 3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - ∘ Features to Look for in an Classifying Cat
  - User-Friendly Interface
- 4. Exploring eBook Recommendations from Classifying Cat
  - Personalized Recommendations
  - Classifying Cat User Reviews and Ratings
  - Classifying Cat and Bestseller Lists
- 5. Accessing Classifying Cat Free and Paid eBooks
  - Classifying Cat Public Domain eBooks
  - Classifying Cat eBook Subscription Services
  - Classifying Cat Budget-Friendly Options
- 6. Navigating Classifying Cat eBook Formats

- o ePub, PDF, MOBI, and More
- Classifying Cat Compatibility with Devices
- Classifying Cat Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Classifying Cat
  - Highlighting and Note-Taking Classifying Cat
  - Interactive Elements Classifying Cat
- 8. Staying Engaged with Classifying Cat
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Classifying Cat
- 9. Balancing eBooks and Physical Books Classifying Cat
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Classifying Cat
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Classifying Cat
  - Setting Reading Goals Classifying Cat
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Classifying Cat
  - Fact-Checking eBook Content of Classifying Cat
  - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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