IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876
 Journal Volume 10, Iss 11, 2021

DEEP LEARNING TRANSFER FOR HEALTH MONITORING WITH FALL DETECTION

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ABSTRACT

Accidental falls are a major source of loss of autonomy, deaths, and injuries among the elderly. Accidental falls also have a remarkable impact on the costs of national health systems. Thus, extensive research and development of fall detection and rescue systems are a necessity. Technologies related to fall detection should be reliable and effective to ensure a proper response. This article provides a comprehensive review on state-of-the-art fall detection technologies considering the most powerful deep learning methodologies. We reviewed the most recent and effective deep learning methods for fall detection and categorized them into three categories: Convolutional Neural Network (CNN) based systems, Long Short-Term Memory (LSTM) based systems, and Auto-encoder based systems. Among the reviewed systems, three dimensional (3D) CNN, CNN with 10-fold cross-validation, LSTM with CNN based systems performed the best in terms of accuracy, sensitivity, specificity, etc. The reviewed systems were compared based on their working principles, used deep learning methods, used datasets, performance metrics, etc. This review is aimed at presenting a summary and comparison of existing state-of-the-art deep learning based fall detection systems to facilitate future development in this field.

INDEX TERMS Auto-encoder, convolutional neural network, deep learning, fall detection, long short-term memory, recurrent convolutional network, recurrent neural network, review, surveillance system

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1.INTRODUCTION

In India, only 1.9 millions hospital beds in all kind hospitals are currently available for population around 1.35 billion that is, only 1.4 beds per 1000 peoples. This situation is also not far better in other countries. In addition, those countries that are comparably on top of that list also may not be able to cope with the challenges arising from a pandemic. Therefore, home health services need to be improved to cope with a pandemic or epidemic such as COVID-19. Moreover, as the parentage of aged people(elders) is increasing steadily , so home health services, are also very useful health practice for elders who live at home. As Artificial Intelligence (AI) is augmenting human capabilities for many human-centred tasks. Therefore, AI could also assist home health services in many ways . Automated patient or elders monitoring (in short we are calling it 'Home Health Monitoring') one such non-intrusive and economical sub-area of these services;

ISSN PRINT 2319 1775 Online 2320 7876
 Journal Volume 10, Iss 11, 2021

these sub-area may include activity monitoring, sleep monitoring, respiration monitoring, fall detection, facial expression understanding, speech recognition, hand hygienic practice monitoring, etc.. For these kind of tasks, deep learning (DL) and computer vision (CV) are very effective as studied. But DL especially for tasks of CV, required GPU-enabled computing devices , which may not be available for every household. To address this issue, one approach is to leverage cloud computing technique, where data needs to be sent to a remote cloud server for processing outside from home. But in this case, privacy, security and bandwidth scarcity are big issues and real-time computing may not be possible. These disincentives motivate to use the new technology of Edge Computing (EC). EC could be used to compute data of home health monitoring inside the home or house. However, some challenges also exists as edge devices(ED) are generally small and have low computing capabilities. In addition, the DL-based model usually takes a large amount of data which is also a big challenge for health sectors. In this article, we propose a deep transfer learning-based edge computing method for home health monitoring (TL-ECHM). Here, we consider a transfer learning approach, where a pre-trained Convolutional Neural Network -based model which is trained with its available dataset, may use in ED with fine-tuning using a small amount of ground labeled dataset. In this way, it would take much less computing resources and the required on-site visual computing shall be possible at an ED. Therefore, mitigation of the abovementioned challenges shall be possible. A possible working scenario of TL-EC-HM is depicted in Fig. 1, where how a caregiver center, cloud server, ED, and IoT device(sensor) are connected to each other to form a system is shown. The highlights of this article are listed as below:

- We provide a study on health and activity monitoring for patient as well as elders at their home for mitigating health crisis.
- We propose a method (TL-EC-HM) based on DTL and EC for home health monitoring.
- We analyze the proposed privacy-preserving TL-EC-HM for on-site visual computing.
- We provide some future research directions.

1.1 Objective of the Project

The health-care gets huge stress in a pandemic or epidemic situation. Some diseases such as COVID-19 that causes a pandemic is highly spreadable from an infected person to others. Therefore, providing health services at home for noncritical infected patients with isolation shall assist to mitigate this kind of stress. In addition, this practice is also very useful for monitoring the health-related activities of elders who live at home. The home health monitoring, a continuous monitoring of a patient or elder at home using visual sensors is one such nonintrusive sub-area of health services at home. In this article, we propose a transfer learning-based edge computing method for home health monitoring. Specifically, a pre-trained convolutional

ISSN PRINT 2319 1775 Online 2320 7876
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neural network-based model can leverage edge devices with a small amount of ground-labeled data and fine-tuning method to train the model. Therefore, on-site computing of visual data captured by RGB, depth, or thermal sensor could be possible in an affordable way. As a result, raw data captured by these types of sensors is not required to be sent outside from home. Therefore, privacy, security, and bandwidth scarcity shall not be issues. Moreover, real-time computing for the above-mentioned purposes shall be possible in an economical way. Keywords—AI-enabled Health Monitoring, Ambient Intelligence, Computer Vision, COVID-19 Pandemic, Deep Learning, Edge Computing, Transfer Learning, Visual Sensors

2. LITERATURE SURVEY

"Covid19 in india : State-wise estimates of current hospital beds, intensive care unit (icu) beds and ventilators,"

Back ground The rapid spread of COVID-19 globally has prompted policymakers to evaluate the capacity of health care infrastructure in their communities. Many hard-hit localities have witnessed a large influx of severe cases that strained existing hospitals. As COVID-19 spreads in India, it is essential to evaluate the country's capacity to treat severe cases.

"Hospital readiness for covid-19," Hospitals play a critical role within the health system in providing essential medical care to the community, particularly in a crisis. Prolonged and combined outbreaks can lead to the progressive spread of disease with rapidly increasingservice demands that can potentially overwhelm the capacity of hospitals and the health system at large. To enhance the readiness of the health facilities to cope with the challenges of the outbreak, a pandemic, or any other emergency or disaster, hospital managers need to ensure the initiation of relevant generic priority action. This document aims to provide a checklist of the key action to take in the context of a continuous hospital emergency preparedness process.

This checklist has been prepared with the aim of supporting hospital managers and emergency planners in achieving the above by defining and initiating actions needed to ensure a rapid response to the COVID-19 outbreak. The checklist is structured on eleven key components; under each component, there is a list of questions regarding the status of implementation of the recommended action specific to that component. Hospitals at risk of increased health service demand should be prepared to initiate the implementation of each action promptly. The section on "Recommended reading" lists selected tools, guidelines and strategies relevant to each component, as well as other supporting documentation,

"The practical implementation of artificial intelligence technologies in medicine,"The development of artificial intelligence (AI)-based technologies in medicine is advancing rapidly, but real-world clinical implementation has not yet become a reality. Here we review some of the key practical issues surrounding the implementation of AI into existing clinical workflows, including data sharing and privacy, transparency of algorithms, data standardization, and interoperability across multiple platforms, and

ISSN PRINT 2319 1775 Online 2320 7876
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concern for patient safety. We summarize the current regulatory environment in the United States and highlight comparisons with other regions in the world, notably Europe and China..

"Sceh: smart customized e-health framework for countryside using edge ai and body sensor networks," Due to the shortage and unbalance of medical resources, it is difficult for patients in the countryside to get high-quality and timely medical services from the central medical facility. Existing researches of fog e-health has the potential of providing real-time medical services for the countryside with body sensor networks (BSN), but there are two limitations. On one hand, because of the medical services requiring not only low-latency but also high-quality, constructing an AI e-health service on resource-constrained fog with edge AI is necessary but unsolved. On the other hand, because of the regional differences in disease risk, there is a lack of an effective mechanism to provide a customized fog AI e-health service for patients in different regions. To address these issues, a smart customized e-health (SCEH) framework is proposed in this paper to provide edge-intelligent and customized medical services for the countryside. Firstly, semantics-based lightweight and meticulous load management mechanism is designed to reduce data load and involve medical semantic. Secondly, model-ensemble based fog AI collaborative analysis mechanism is proposed for load balance and knowledge integration. Thirdly, an attention-weight based customized fog AI e-health generation mechanism is devised for regional medical model reconstruction. The simulation results demonstrate the effectiveness of SCEH which ensures both the accuracy and low latency of fog e-health with limited resource.

"A nurse-driven method for developing artificial intelligence in "smart" homes for aging-in-place," To offer practical guidance to nurse investigators interested in multidisciplinary research that includes assisting in the development of artificial intelligence (AI) algorithms for "smart" health management and aging-in-place.

"Homecare robotic systems for healthcare 4.0: Visions and enabling technologies," Powered by the technologies that have originated from manufacturing, the fourth revolution of healthcare technologies is happening (Healthcare 4.0). As an example of such revolution, new generation homecare robotic systems (HRS) based on the cyber-physical systems (CPS) with higher speed and more intelligent execution are emerging. In this article, the new visions and features of the CPS-based HRS are proposed. The latest progress in related enabling technologies is reviewed, including artificial intelligence, sensing fundamentals, materials and machines, cloud computing and communication, as well as motion capture and mapping. Finally, the future perspectives of the CPS-based HRS and the technical challenges faced in each technical area are discussed.

"Remote patient monitoring: a comprehensive study,"

Lifestyle influences morbidity and mortality rates in the world. Physical activity, a healthy weight, and a healthy diet are key

preventative health behaviours that help reduce the risk of developing type 2 diabetes and its complications, such as cardiovascular disease. A healthy lifestyle has been shown to prevent or delay chronic diseases and their complications, but few people follow all recommended self-management behaviours. This work seeks to improve knowledge of factors affecting type 2 diabetes self-management and prevention through lifestyle changes. This paper describes the design, development, and testing of a diabetes self-management mobile app. The app tracked dietary consumption and health data. Bluetooth movement data from a pair of wearable insole devices are used to track carbohydrate intake, blood glucose, medication adherence, and physical activity. Two machine learning models were constructed to recognise sitting and standing. The SVM and decision tree models were 86% accurate for these tasks. The decision tree model is used in a real-time activity classification app. It is exciting to see more and more mobile health self-management apps being used to treat chronic diseases.

"Vision-based patient monitoring: a comprehensive review of algorithms and technologies."

Vision-based monitoring for assisted living is gaining increasing attention, especially in multi-modal monitoring systems owing to the several advantages of vision-based sensors. In this paper, a detailed survey of some of the important vision-based patient monitoring applications is presented, namely (a) fall detection (b) action and activity monitoring (c) sleep monitoring (d) respiration and apnea monitoring (e) epilepsy monitoring (f) vital signs monitoring and (g) facial expression monitoring. The challenges and state-of-art technologies in each of these applications is presented. This is the first work to present such a comprehensive survey with the focus on a set of seven most common applications pertaining to patient monitoring. Potential future directions are presented while also considering practical large scale deployment of vision-based systems in patient monitoring. One of the important conclusions drawn is that rather than applying generic algorithms, use of the application context of patient monitoring can be a useful way to develop novel techniques that are robust and yet cost-effective.

3. SYSTEM ANALYSIS

SYSTEM ARCHITECTURE:

3.1 EXISTING SYSTEM

Health monitoring is the monitoring of a worker by doctors to identify changes in their health status because of exposure to certain substances. If you are a person conducting a business or undertaking (PCBU), you must provide health monitoring to workers if there is a significant risk to workers health because of exposure to a hazardous chemical.

Disadvantage

1.time taken process

3.2 PROPOSED SYSTEM

A pandemic or epidemic crisis puts a lot of strain on the medical system. Some illnesses, like COVID-19, which creates a pandemic, are very contagious when someone is infected with them. others. Therefore, giving medical

ISSN PRINT 2319 1775 Online 2320 7876
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care at home for patients who are not in severe condition and who are placed in isolation will help to reduce particular form of pressure. Furthermore, this technique is really beneficial. for keeping an eye on the health-related activities of elderly residents at home. The home health monitoring is a persistent watch of One such nonintrusive division of at-home medical care involves a patient or elderly person employing visual sensors. This article explores suggest an edge computing approach based on transfer learning for health monitoring at home. An especially trained convolutional Using edge devices with a neural network-based model tiny quantity

Advantage

1.More Accuracy.

2.quick response.

IV.IMPLAMENTATION

MODULES DISCRIPTION

To implement this project we have designed following modules

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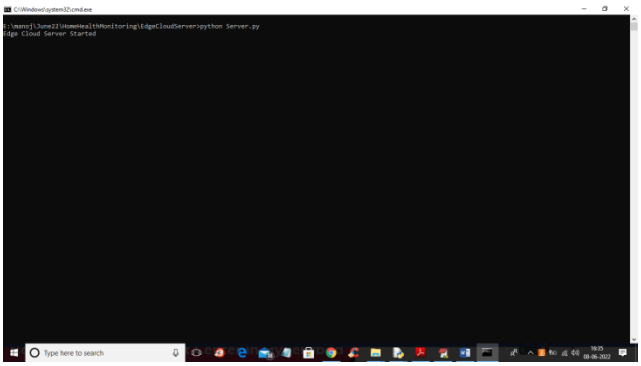
1) Edge Cloud Server: this is a cloud application which received images from client and display to medical peoples for monitoring

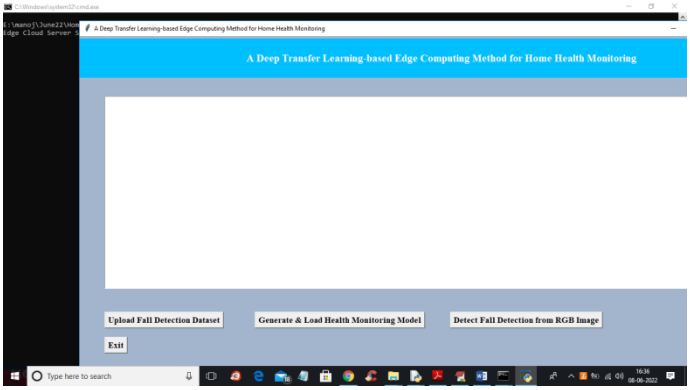
2) AI Sensor Client Application: this module we will upload dataset to train AI model and then load the model and whenever user upload any images then it will predict condition and report to cloud server.

V.SCREEN SHOTS:

To run project first double click on 'run.bat' from 'EdgeCloudServer' folder to start cloud server and get below screen



In above screen we can see edge cloud server started and now double click on 'run.bat' file from 'AISensors' folder to start client sensor application and get below output



In above client application user can click on 'Upload Fall Detection Dataset' button to upload dataset and get below output

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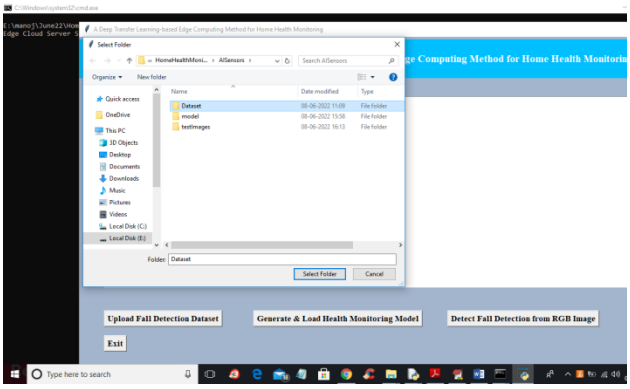
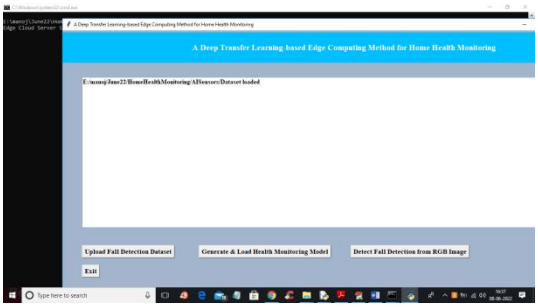
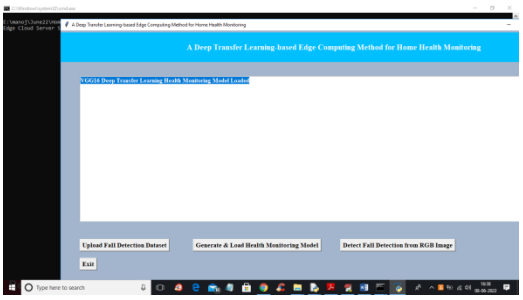
 Journal Volume 10, Iss 11, 2021



In above screen selecting and uploading 'Dataset' folder and then click on 'Select Folder' button to load dataset and get below output



In above screen dataset loaded and now click on 'Generate & Load Health Monitoring Model' button to load model and get below output



In above screen VGG16 transfer learning model loaded and now click on 'Detect Fall Detection from RGB image' button to upload image and get below output.

VI.CONCLUSION

To mitigate the health crises in a pandemic or to take care elders in an affordable way, home health monitoring would be very beneficial. In this article, we have proposed a computer vision-based method where a deep transfer learning is used in edge devices as edge computing. In this approach, the raw visual data continuously capture by visual sensor(s) is not required to be sent outside of home. Therefore, privacy, data security as well as latency are not big issues.

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