*LITERATURE SURVEY*

AI-POWER NUTRITION ANALYZER FOR FITNESS ENTHUSIASTS

PROBLEM 1

By referring IEEE this below abtracts are taken Artificial Intelligence (AI) has the potential to transform US food systems by targeting its biggest challenges: improving food yield, quality, and nutrition, decreasing resource consumption, increasing safety and traceability, and eliminating food waste. Despite big leaps in AI capacity, food systems present several challenges for the application and adoption of AI: (1) Food systems are highly diverse and biologically complex, (2) ground-truth data is sparse, costly, and privately held, and (3) human decisions and preferences are intricately linked to every stage of food system supply chains. To address these challenges and transform U.S. food systems, the AI Institute for Next Generation Food Systems (AIFS) aims to develop AI technologies and nurture the next generation of talent to produce and distribute more highquality nutritious food with fewer resources. AIFS has six research clusters, including two Foundational Research Areas (Use-Inspired and Foundational AI, and Socioeconomics and Ethics) and four Application Research Areas spanning the entire food supply chain: Molecular Breeding, Agricultural Production, Food Processing and Distribution, and Nutrition. AIFS is developing generalizable, data efficient, and trustworthy AI solutions based on a knowledge-driven and human-in-theloop learning paradigm designed to handle food system diversity and biological complexity, efficiently capture, and utilize food system data, and garner user trust via explainability, safety, privacy, and fairness.

**INTRODUCTION**

Artificial Intelligence (AI) has the potential to transform US food systems by targeting its biggest challenges: improving food yield, quality, and nutrition, decreasing resource consumption, increasing safety and traceability, and eliminating food waste. To transform US food systems by innovating AI technology that will generate actionable information for diverse stakeholders in food system supply chains, grounded in a robust ethical and socioeconomic framework. Toward this goal and addressing the above challenges, AI will develop generalizable, data-efficient, and trustworthy AI solutions to enable Molecular breeders to discover and/or design the next generation of high yielding, high-quality, consumer-focused foods, Agricultural producers to maximize food quantity and quality, while minimizing resource consumption and waste, (3) Food processors and distributors to deliver highly traceable and safe food, while minimizing resource consumption and waste, and (4) Consumers to rapidly and precisely assess the nutrition of a meal, quantify the food’s molecular composition, and predict the impact on their health.

**NUTRITION**

The endpoint of the food system is nutrition–the consumption of food to sustain human life and, preferably, to enhance health and well-being. AI technologies are advancing the field in several areas. AI/ML have been used to assess diet via food photography. Once a human participant’s food intake is known, those foods are translated to nutrients using food composition tables. While it is not feasible to analyze the composition of every food item, it should be possible to build models from labelled data sets to predict the composition of new foods.

**FOOD PROCESSING AND DISTRIBUTION**

The key challenges in the food processing and distribution are food safety, food loss and spoilage, and process innovation/optimization. To address the challenges of food safety, we will develop AI models that can flexibly integrate the existing food microbial ecology, chemometric and physical data sets for comprehensive assessment of food safety risks from farm to retail distribution. These existing data sets will be supplemented with digital twin models of food processing operations.

**MOLECULAR BREEDING**

The molecular breeding cluster focuses on developing AI tools for breeding the next generation of high yielding, high-quality, consumer focused varieties of vegetables, fruit, and nut crops. We aim to address the following three challenges unique to horticultural crop improvement: The diversity of horticultural crops requires highly specialized breeding approaches. Specialized tools for breeding developed in one species do not necessarily perform well in another. Yield data is collected by hand, incurring high labor costs. Fruit and vegetable quality is multi-faceted and is subject to context-dependent consumer preferences whereas existing tools for AI-enabled breeding are best suited for a single trait target .

**AG PRODUCTION**

Agricultural production requires substantial inputs (e.g. water, fertilizer, pesticides, energy, and labor) to maximize the output of food quantity and/or quality. Agricultural production is extremely diverse in terms of environmental conditions, crop traits, and management strategies. The AIFS Agricultural Production cluster is focused on developing AI tools that enable agricultural producers to sustainably manage the diversity of horticultural crops – maximizing food yield and quality, while minimizing resource consumption and waste.

**CONCLUSION**

To develop food system-centric AI solutions for transforming productivity, sustainability, and safety of food systems as well as enhancing consumer health and wellness. These AI solutions will innovate algorithms and computational resources to model both diversity and biological complexity of food systems and create explainable and trustworthy predictions to engage human in-the-loop. These innovations are significantly and intellectually distinct from the current scenario where AI approaches in food systems are exclusively technological by-products of other industries. AI innovations into the food system and nurture the next generation of talent to enable a more resilient and productive society .now , we are including some function when users sit in a restaurant when the app is pointed to menu . we can download the nutrition content what are involve in the dish by using AI in nutrition. This analyzing tool uses artificial intelligence to measure food products quantitative and qualitative properties without harming them. Its focus is on biophysical and biochemical metrics to detect food contaminants and decay curves to determine lives . Moreover, it predicts harvesting, ripening and processing time to get an earlier estimation.

**PROBLEM 2**

The food pattern is considered one of the modifiable factors for improving lifestyle and disease prevention. It is known that both negative and positive changes in diet have an effect on the evolution of diseases such as obesity, depression, anxiety, type 2 diabetes (T2D), and cardiovascular diseases (CVD). In order to improve the evolution of chronic diseases, changing eating habits is strongly recommended. This change must be assisted by dieticians, who are trained for the function of nutrition care. consider four main functions of nutrition care: (i) Assessment, (ii) Diagnosis, (iii) Intervention, and (iv) Monitoring and Evaluation. The term fitness is related to adaptation to an aesthetic model, which includes physical activity and food diets. As fitness has long been added to the word physical, it gave rise to the term physical fitness. The AI has been a strategy used also in the prevention of diseases and improvement in the quality of life from the practice of physical activities that propitiate the development of the physical fitness oriented to the health also in the context of the rehabilitation.

**INTRODUCTION**

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**PRECISION NUTRITION AND PRECISION FITNESS**

The precision nutrition aims to “develop effective approaches based on the combination of an individual’s genetic, environmental and lifestyle factors.”Precision nutrition will integrate genetic data with phenotypic, social, cultural, and personal preferences and lifestyles to provide individual nutrition, but must also consider public health perspectives where ethical, legal, and political aspects need to be defined and implemented.

**AI WITH PRECISION NUTRITION**

The following are examples of how health information and communication technology combined with AI can contribute to the control and promotion of nutritional health of different population groups.

**DECISION MAKING ALGORITHM FOR NUTRITION PLANNING**

Currently, most people are concerned about healthy eating habits and lifestyle. A solution suggested is the food recommender systems, which aim to help people to change their eating habits as well as choose healthier food. In the area of technology, food and diet are considered as complex domains and bring challenges for recommendation technologies because plenty of food items/ingredients need to be collected. Another factor that turns it so complex is that the ingredients/foods are frequently combined with each other as a recipe. Besides that, food recommender systems “also suggest healthy Introduction 473 food choices, keep track of eating behaviour, understand health problems, and persuade to change user behaviour”.

**AI BASED DIET AND SUPPLEMENTS FOR PREGNANCY**

Nowadays pregnant women are looking for a new tool to find lifestyle information in pregnancy, as well as health information in digital format. It is known that most people have a mobile phone or internet access, which increase the access to information and can help the preconception care of couples. The reproductive and pregnancy outcomes are affected by the obesity and lifestyle of mother and father and can damage the next generations as well as bring consequences in later life. However, improving the parental behaviours is good for the preconception care and pregnancy, even as to decrease the health-care costs. The electronic health (eHealth) and mHealth intended to be used to improve behavioural changes and preserve healthy nutrition and lifestyle by a personalized and individual feedback. In addition, the mHealth is useful because it helps at the medication adherence, when necessary.

**AI USED IN GENETICS TESTS FOR PRECISION NUTRTION AND FITNESS**

AI can be useful for genetic tests to identify possible mechanisms and relationships between nutrients and disease. Naushad et al developed an ANNbased breast cancer prediction model from the data of folate and xenobiotic pathway genetic polymorphisms, considering that increased exposure to estrogen and low folate intake increase breast cancer risk.

**AI APPROACH TO NUTRTION MEAL PLANNING CANCER**

Proper nutrition is extremely important during treatment to fight cancer.The method of nutritional monitoring, through a numerical scale performs the continuous nutritional evaluation, not only a categorical measure, allowing the monitoring of the daily nutritional evolution of these patients. One of the sections is the patient’s history, to be completed by the patient, where a set of questions related to the patient’s physical attributes, food intake, presence of symptoms that inhibit food intake and general activities are identified. It can be used by the patient himself. It also addresses the results of physical examinations and items related to objective nutritional assessment, criteria such as the description of the disease, metabolic demands, and the general evaluation to be completed by the physician. All questions are scored generating a score that varies from no intervention (PG-SGA score 0–1) to a critical need for symptom management and nutritional intervention (PG-SGA score >8).

**CONCLUSION**

Although AI is not yet widely used in the areas of nutrition and fitness, it is found that the current technology available is favourable to the application of AI, since a large amount of data is collected by these technologies and, therefore, AI could be very useful in their mining.In addition to the challenge of using AI more widely for health promotion, prevention, treatment, and recovery, technology resources need to be continuously assessed for usability and accuracy, and be accessible to all, especially the most vulnerable groups, to meet bioethical principles of beneficence, nonmaleficence, autonomy, justice, and equity .In addition , it is an excellent food recognition solution offered by this project that recognizes several food items in a single picture. It calculates food’s nutritional content ,cooking style,added sauces and ingredients this will supports medical and health centers to deliver improved food solutions to patients and offer new insurance products .

***PROJECT 3***

Human action analysis has been an active research area in computer vision, and has many useful applications such as human computer interaction. Most of the state-of-the-art approaches of human action analysis are datadriven and focus on general action recognition. In this paper, we aim to analyze fitness actions with skeleton sequences and propose an efficient and robust fitness action analysis framework. Firstly, fitness actions from 15 subjects are captured and built to a fitness action dataset(FITNESS 28). Secondly, skeleton information is extracted and made alignment with a simplified human skeleton model. Thirdly, the aligned skeleton information is transformed to an uniform human center coordinate system with the proposed spatial–temporal skeleton encoding method. Finally, the action classifier and local–global geometrical registration strategy are constructed to analyze the fitness actions. Experimental results demonstrate that our method can effectively assess fitness action, and have a good performance on artificial intelligence fitness system.

**INTRODUCTION**

The key of intelligent fitness guidance is to realize action recognition and evaluate action quality, that is to distinguish different movements by collecting and analyzing action characteristics. Fitness action analysis is to evaluate what and how well a fitness action is performed.The application of AI fitness, propose a simple yet efficient spatio-temporal skeleton encoding method with RGB videos, and design a novelanalysis method

**human recognize and evaluate fitness actions**

The key idea is to extract 2D movement features through the human body center projection and skeleton compression encoding.

**FITNESS ANALYSIS FRAMEWORK**

It is composed of the following four modules

**FITNESS ACTION CAPTURING**

To collect the visual data of human action, we use two fixed sports cameras around the human to capture the fitness action, and get two conventional RGB videos from two views. At the same time, a fixed depth camera is used to capture the depth information of human body from the front view.

**SKELETON EXTRACTION AND PROCESSING**

In order to analyze the fitness movements with captured human video, we extract the 2D and 3Dhuman skeleton information from the corresponding RGB and RGB-D images through human pose estimation method. For each fitness action, the skeleton sequences of the coach and each subject are aligned with same frame number.

**SKELETON FEATURE ENCODING**

Each skeleton graph is simplified to a new model with 15 key points, which can effectively describe a humanpose. For a 2D/3D skeleton sequence of a complete action, we crop and project each skeleton graph from spatial–temporal domain to an uniform two-dimension plane, and then encode the superposed skeleton graph to a binary feature image to describe a global action.

**FITNESS ACTION ANALYSIS**

Based on the binary skeleton feature, we design multi-class classifiers to recognize the fitness action. The classifiers are trained with the built Fitness-28 dataset. Besides, we design measure metrics to assess the subject’s action performance based on local–global geometrical registration errors.

**FITNESS 28 DATASET**

The proposed Fitness-28 dataset contains 28 kinds of fitness actions, and has been classified to three categories: (i) strength exercises (dumbbell and bare-hand); (ii) stretching exercises (dynamic and static); (iii) combination exercises. For fitness action capturing, two GoPro Hero 7 cameras are used to capture 2D fitness actions from the front view and side view respectively, while a realsense depth camera is used to capture 3D fitness actions from the front view. Fig. 4 describes the position relationship between the subject and the cameras from top view. When a subject performs an action, both cameras shot at the same time.The captured action videos (RGB/RGB-D) have be edited and organized into the 2D/3D Fitness-28 dataset.

**FITNESS ACTION ANALYSIS**

For fitness action analysis, we firstly design multi-class classifiers to recognize the fitness actions, and then use a local–global strategy to evaluate the performance of an identified action based on geometricalcharacteristic.

**FITNESS ACTION RECOGNITION**

The task of fitness action recognition is to classify the exercise types. The designed multi-class classifier is to identify the type of fitness actions, and use a constructed feature vector as input.By designing a lightweight convolutional neural network (CNN) model to classify the fitness action, and the network structure the input is the encoded feature map (24 × 24), and the output is the 28 action categories. After the three-layer convolutional neural network, the calculated feature map can be expanded to 3364 neurons. Then, two full connection (FC) layers with 128 and 28 neurons respectively are added. In each layer, the activation function is the LeakyRelu function. We use the cross entropy to computer the loss for the action recognition loss. Dropout is added after each fully connected layer, and set to 0.5 in our experiment. In practical applications, the proposed SVM and CNN algorithms can be chosen by the computing capacity of the device.

**FITNESS ACTION ASSESSMENT**

The task of fitness movement assessment is to introduce a measure metric between two action features from the coach and a subject. For action assessment, we have to align the action skeleton sequences from the coach and a subject, and then make skeleton feature encoding respectively. Based on ICP algorithm, we make a local–global evaluation to estimate the difference of actions between the coach and the subject. Each feature point in a subject’s data set can be paired with the closest feature point in the coach’s data set to form correspondence pairs during the ICP iterations.Action assessment grades the movements of the subject and gives real time training feedback.

**ACTION ASSESSMENT RESULT**

For action assessment, we evaluate the performance of our method with 3D feature on Fitness-28 dataset in terms of ICP score, Spearmans rank correlation, and global score function.The action assessment with 3D skeleton information for a subject compared to the coach. Assessment results with global feature, and the dimension of global feature is fixed to 24 × 24 × 24. The first column is the 3D skeleton trajectories of the coach, and the second column is the skeleton trajectories of the subject with global action quality score and ICP criteria. Compared with action 1, the feature trajectory of action 24 from the subject is more similar to the coach’s feature trajectory, and have higher action quality score and ICP criteria. We section four 2D local feature images from 3D features in the Z-axis (depth) direction . The first row and the third row show the feature images of the coach, and the second row and the fourth row show the feature images of the subject with Spearman’s rank correlation. It can be seen that the more similar feature images, the higher Sp.corr. scores.

**CONCLUSION**

In this , we aim to recognize and assess the fitness action in Ai fitness system, and propose an efficient fitness action analysis framework with spatial–temporal skeleton encoding. For action quality assessment, we construct three evaluation metrics with local and global action features. Experimental results demonstrate that our approach has good performance on the proposed Fitness-28 dataset and small-scale public datasets. Furthermore, increasing the recognition and assessment accuracy of complex dynamic movements is the direction of our future work. To improve the robust of AI fitness system, we will consider the relationships of the camera, human and environment, and explore action analysis methods with freely moved cameras.

Fitness guidance is to realize action recognition and evaluate action quality, that is to distinguish different movements by collecting and analyzing action characteristics.Here we adding some music for relaxation while taking rest . then one action is completed it will give some time to take rest after that it will restart automatically.In addition to that it will visualize some sample action (real scenario) by using Ai and give instruction louder to encourage user .