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A Novel HNN-DOC for Automated Agricultural Ontology Construction on Climate Factors

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Abstract*: Ontology has a huge potential for enhancing data association, executives, and understanding. One important criterion of domain ontologies is that they should accomplish a high level of inclusion of the domain concepts and concept relationships. However, the improvement of these ontologies is regularly a manual, time consuming, and frequently results in error. This problem leads towards the need for automation of ontology construction. Agriculture is a critical domain in our country faces problem due to the lack of knowledge on cropping pattern exclusively after the adverse effects of global warming. This paper gives a novel Hybrid Neural Network for Agricultural Ontology Construction (HNN-AGOC) for farmers through the Agro-Pedia dataset for predicting cropping automatically. The HNN-AGOC comprised of Convolutional Neural Network (CNN) for classifying the extracted features and Recursive Neural Network (RNN) for prediction in ontology construction. The algorithm was initially trained with the training dataset, and the performance analysis was performed on different performance metrics. The HNN-AGOC algorithm achieved the overall accuracy, precision, and recall values as 85.23%, 70.10%, and 80.24 % respectively.

***Keywords* : Ontology Construction, Agriculture, CNN, RNN, Climate.**

I. INTRODUCTION

Domain knowledge models are developed using Ontology through concepts graphs that prompt different semantic and taxonomic relations across those concepts [1]. Additionally, ontology exist in both Formal and Explicit: i.e., the concepts category and the usage constraints must be defined explicitly, and - Shared [2]. A label was generated which expresses the specific theme idea. Relations represent specialization, generalization, or links that are semantic among concepts and they allow taxonomy building. Axioms use relations and concepts assertions allowing their representations in semantic form. Generally, instances are of concepts with concrete objects. [3].

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Agriculture is the economic backbone for any given country, especially in India where it plays a significant role in its gross domestic product (GDP). In addition to providing raw materials for food, it provides occupation chances to about 70% of the population, either directly or indirectly[4]. The most significant problem faced by the Indian framer is that they are not getting any proper support and timely help from the government and other helping organizations over planning and cropping of the plant. Especially after the adverse impacts of global warming, hence there is a need for knowledge support to help the framer in choosing the crops.

For accomplishing the need a valid construction of the agricultural ontology with, the novel Hybrid Neural Network for Agricultural Ontology Construction (HNN-AGOC) was proposed. The Agro-Pedia dataset was employed for the ontology construction. The constructed ontology was evaluated for its performance using different performance metrics.

II. LITERATURE REVIEW

In [5] employs a complete AGROVOC Linked Dataset description maintenance details for process of publication. AGROVOC is accomplished and owned by FAO, preserved by an international experts community and active institutions in the agriculture area. AGROVOC is widely used in specialized libraries as well as digital libraries and repositories to index content. It is also employed as specialized resource of tagging for content and knowledge organization by other third-party and FAO stakeholders.

In [6] examined the challenge of relating a set of visual features to topics of interests using a deep learning framework. A typical novel framework was established, named "DeepVisInterest," for predicting users' interests from social visual data applying mainly the Convolutional Neural Network (CNN) architectures for feature extractor and classification modules. The results were systematically evaluated the proposed framework regarding our proposed social visual data database contains over 24000 social images from 240 Facebook accounts. The results demonstrated the superiority of the approach over the literature regarding both accuracy and the evolution of time.

In [7] proposed a deep learning model for ontologyconstruction in predicting behavior of human and their health with social network. By including complete behaviour of human self-motivation determinants, inner and outer social influences, and social events, the proposed model predicts the future movement levels of employers more precisely and stable than existing methods.

The ORBM+ model represented all correlations between the determinants, with key personal characteristics which were reliably extracted and utilized to generate improved explanations through proposd model compared with original human behaviors.

In [8] presented an algorithm of multi-level deep learning for adapting increasingly multiple deep networks and discriminative tree classifier together, where multiple deep CNNs are adapted at the same time to accomplish progressively discriminative representations of both the coarse-grained and the fine-grained classes of object at various concept dimensions in ontology. The exhibited MLDL algorithm has achieved exceptionally focused results on both the computational proficiency and accuracy rates for visual recognition in large-scale.

In [9] presented a developing technique for automatic extraction of relationships and vocabulary between the terms which are fundamental in the creation in the ontology. This paper recognized a baseline algorithm modified Open Information Extraction (mOIE) which works on WordNet-based correspondence for identifying diverse relationships. The proposed method primarily resorted to recalling scheming through the terms present in AGROVOC.

In [10] presented a disease prediction techniques by obtaining the optimal disease rules with the genetic algorithm. The outcome of the genetic algorithm was used to train the Feed forward ANN and predict the diseases based on the symptoms. The proposed model provided higher accuracy in disease prediction than the existing models.The proposed model can be implemented in the real time applications.

In [11] provided a multiple ontologies for extracting the semantic similarities for secure retrieval of document in the cloud. The proposed similarity measure identify the association between the query and the document through query expansion technique and model for personalization was developed. The proposed method was evaluated as the MAP and the F-measure value attained was better than the existing techniques in document retrieval.

In [12] retrived the social information through cross ontology mapping in which both the word net and sweto generated the datasets. The ontology was constructed with and without semantic annotions with and without hashing technique. The proposed hybrid methods provide very effective ontology construction than the existing models.

III. RESEARCH METHODOLOGY

The current method for ontology construction was given in figure 1. The initial phase in the present ontology construction was on collection of the appropriate agricultural data. The dataset for the agricultural ontology was acquired from Agropedia. Agropedia is a seamlessly integrated, comprehensive digital content model organization in the domain of agriculture. The Agro-Pedia is a platform for bridging the gap between farmers and researchers by consenting many diverse organizations and people to participate, collaborate, and interact.

The dataset was preprocessed to reduce the prevalence of its inconsistencies with the latent factor model. Subsequently the dataset was segmented into two forms namely the testing dataset and training dataset at a ratio of 70:30. The training dataset was initially provided to the HNN-DOC algorithm to train them on extracting different attributes on climate and classify them accordingly. Based on the training, the ontology construction model was developed and was tested with the complete dataset on agriculture.

The attributes of the ontology construction are as follows: temperature, rainfall, wind flow, humidity, and precipitation. The corresponding range values are given in table 1. The training of the novel HNN-DOC was carried out effectively in which the dataset was processed through CNN initially to classify the attributes. Then the classified data were fed into the RNN layer that predicts the crops. Our ontology construction has included the prediction of crop for different climate.

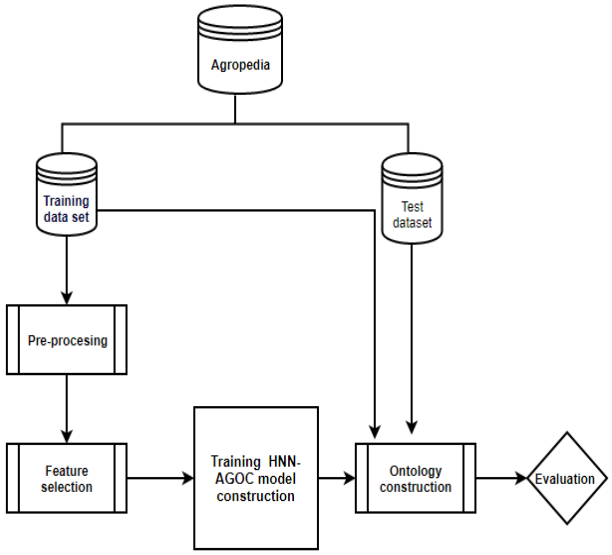

Fig.1 HNN-AGOC based agricultural ontology construction

Table.1 Attributes for ontology construction

Attribute No.	Attribute	Unit	Range
A1	Rainfall	mm	0-2500
A2	Temperature	°C	-20- 75
A3	Wind flow	Km/hr; direction	0-250
A4	Humidity	%	0-100
A5	Precipitation	mm	0-2500

The following performance metrics were used to evaluate the constructed ontologies on agriculture as:

Precision for the given algorithm is defined as the ratio of several correctly related terms to the total number of terms extracted.

$$precision = \frac{number\ of\ correct\ related\ pairs\ of\ terms\ extracted}{\text{total number of pairs of terms extracted}} \times 100 \ldots\ldots (1)$$

Recall is the ratio of the relevant terms that were extracted by the proposed algorithm.

$$R = \frac{number\ of\ correct\ related\ pairs\ of\ terms\ extracted}{total\ number\ of\ related\ pairs\ of\ terms\ in\ the\ data\ set} \times 100 \ldots\ldots\ldots\ldots (2)$$

Accuracy was the exactness in which the features are extracted and predicted the crop for a given climate condition

$$Accuracy = \frac{total\ correct\ terms}{total\ extracted\ terms} \times 100 \ldots\ldots\ldots (3)$$

IV. RESULT AND DISCUSSION

From the evaluation of the constructed ontology, the following results are obtained:

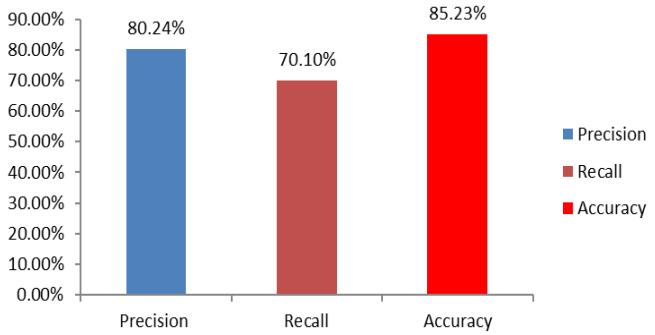

Fig.2 Performance Analysis

The performance of ontology largely depends on the extracted pair terms and the similarity between them. The most common metrics to evaluate any ontology was its accuracy or exactness to achieve the effective ontology for any domain.The accuracy of the proposed agricultural ontology attains 85.23%. The precision is another important metric that deliberate the effectiveness of ontology based on the query for which the information needed to be extracted. Unlike accuracy, it discusses the relationship between the terms extracted to the total number of extracted terms.In our proposed algorithm over the agropedia, the precision value was found as 80.24%. The recall value was obtained as 70.10%, which reflect the correctness among the term pairs that are extracted from Agro-Pedia for the construction of climate based agricultural ontology.

V. CONCLUSION

This paper proposed a novel HNN-AGOC algorithm for automatic ontology construction methods for predicting crop over different climate. The Agro-Pedia dataset was segmented into training and testing dataset and employed in our ontology construction. The CNN involved in the algorithm deals with the classification of data, and the RNN was employed to predict the crop. The performance analysis was carried out on the overall ontology construction along with sub-classes construction. From the analysis, it was observed that the proposed algorithm achieved the overall accuracy of about 85.23%. The precision and recall value of the proposed algorithm was about 80.24% and 70.10%. The proposed algorithm can be implemented for predicting crop through different agricultural attributes in future.

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