FORM 1 THE PATENTS ACT, 1970 (39 of 1970) & THE PATENTS RULES, 2003 APPLICATION FOR GRANT OF PATENT [See sections 7, 54 & 135 and rule 20(1)]	(FOR OFFICE USE ONLY) Application No.: ..... Filing Date: ..... Amount of Fee Paid: ..... CBR No.: ..... Signature: .....

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3. TITLE OF THE INVENTION: **A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning**

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5. PRIORITY PARTICULARS OF THE APPLICATION(S) FILED IN CONVENTION COUNTRY:

Sr.No	Country	Application Number	Filing Date	Name of the Applicant	Title of the Invention

6. PARTICULARS FOR FILING PATENT COOPERATION TREATY (PCT) NATIONAL PHASE APPLICATION:

International Application Number	International Filing Date as Allotted by the Receiving Office
PCT//	

7. PARTICULARS FOR FILING DIVISIONAL APPLICATION

Original (first) Application Number	Date of Filing of Original (first) Application

8. PARTICULARS FOR FILING PATENT OF ADDITION:

Main Application / Patent Number:	Date of Filing of Main Application

9. DECLARATIONS:

(i) Declaration by the inventor(s):

I/We, Prof. James Stephen Meka, Mr.K.Nani Kumar, and Prof. Prasad Reddy P.V.G.D., is/are the true & first inventor(s) for this invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a)Date: ----- Dated this 28th day of September, 2021

(b)Signature(s) of the inventor(s): .....

(c)Name(s):
Prof. James Stephen Meka

Mr.K.Nani Kumar

Prof. Prasad Reddy P.V.G.D.

(ii) Declaration by the applicant(s) in the convention country:

I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a)Date: ----- Dated this 28th day of September, 2021

(b)Signature(s) of the inventor(s): .....

(c)Name(s):
Prof. James Stephen Meka

Mr.K.Nani Kumar

Prof. Prasad Reddy P.V.G.D.

(iii) Declaration by the Applicant(s):

- **The Complete specification relating to the invention is filed with this application.**
- **I am/ We are, in the possession of the above mentioned invention.**
- **There is no lawful ground of objection to the grant of the Patent to me/us.**

10. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION:

Sr.No	Document Description	File Name
1	Complete Specifications(Form-2)	CompletespecificationsForm2.pdf
2	Drawings	Drawings.pdf
3	Request For Early Publication(Form-9)	Form9.pdf
4	Statement of Undertaking (Form 3)	Form3.pdf
5	Declaration of Inventorship (Form 5)	Form5.pdf

I/We hereby declare that to the best of my/our knowledge, information and belief the fact and matters stated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this (Final Payment Date): --------

Signature: .....

Name(s):

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Mr.K.Nani Kumar

Prof. Prasad Reddy P.V.G.D.

To

The Controller of Patents

The Patent office at CHENNAI

(12) PATENT APPLICATION PUBLICATION
(19) INDIA
(22) Date of filing of Application :28/09/2021

(21) Application No.202141044038 A
(43) Publication Date : 08/10/2021

(54) Title of the invention : A NOVEL EARLY DIABETIC COMPLICATION LEARNING MODEL (EDCLM) USING HYBRID GENETIC ALGORITHMS AND DEEP LEARNING

(51) International classification :G06N 3/12
(86) International Application No :NA
Filing Date :NA
(87) International Publication No : NA
(61) Patent of Addition to Application Number :NA
Filing Date :NA
(62) Divisional to Application Number :NA
Filing Date :NA

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(57) Abstract :
Diabetes is now one of the world"s most common, chronic, and deadly diseases due to its complications. Diabetes detection at an early stage is essential for timely treatment because it can stop disease progression. A model that can predict the occurrence of diabetes in the future but also determine the type of disease that a person experiences in diabetes is required. The present invention disclosed herein is a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early. The model can be implemented in three phases in which Hybrid Genetic Algorithm-1 (104) comprising of: Initialize Heuristic, Genetic Sharp, and Local Optimization is performed in first phase; the Hybrid Deep Learning System (105) comprising of: Fuzzification; Deep Learning Model; Rule Base; Inference; and Defuzzification is used in second phase; the Hybrid Genetic Algorithm-2 (106) comprising of: Crossover; and Prediction is performed in third phase. The present invention disclosed herein is evaluated on the openly available Diabetes Patient Datasets and the evaluation shows that the model in the proposed disclosure is capable of providing early diabetic Prediction depending on the patient"s health. The model in the disclosure provided 94.1458% of Accuracy, 94.2327% of Specificity and 94.0126% of Sensitivity for patient dataset over 242344 records.

No. of Pages : 22 No. of Claims : 10

FORM 2

THE PATENTS ACT, 1970

(39 of 1970) &

THE PATENTS RULES, 2003

COMPLETE SPECIFICATION

(See section 10, rule 13)

1. TITLE OF THE INVENTION:

A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning

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3. PREAMBLE TO THE DESCRIPTION:

COMPLETE SPECIFICATION

The following specification particularly describes the invention and the manner in which it is to be performed.

A NOVEL EARLY DIABETIC COMPLICATION LEARNING MODEL (EDCLM) USING HYBRID GENETIC ALGORITHMS AND DEEP LEARNING

FIELD OF INVENTION

The present invention relates to the technical field of Computer Science Engineering.

Particularly, the present invention is related to a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning of the broader field of Artificial Intelligence in Computer Science Engineering.

More particularly, the present invention is related to a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning provides a multitask learning model for a healthcare systems to detect Diabetic Complication early. The EDCLM can predict the occurrence of diabetes in the future but also determine the type of disease that a person experiences in diabetes.

BACKGROUND & PRIOR ART

Human health is being jeopardized on a growing number of fronts by ever-evolving sorts of various diseases. To safeguard the public against new pandemics, diseases healthcare professionals must innovate with new ideas and models. A patient may be diagnosed with multiple diseases, each with its own set of problems. Early detection of diseases enables a patient to receive more effective therapy and keeps the disease's effects on the body to a minimum. Nowadays, diabetes has become a prevalent condition that can afflict people of any age. Diabetes is a dangerous condition that affects a variety of organs in the human body. Diabetics require early detection in order to protect themselves from this fatal disease.

A genetic algorithm (GA) is a technique for solving both limited and unconstrained optimization problems that is inspired by biological evolution's natural selection process. Genetic Algorithms (GA) are a subset of evolutionary methods that are adaptive

heuristic search algorithms. Genetic algorithms are based on natural selection and genetics principles. These are instances of intelligent exploitation of random search combined with historical data in order to lead the search into the region of solution space with the best performance. They are frequently utilized to develop high-quality solutions for classification, prediction and search-related issues.

Supervised Learning Algorithms make predictions and support decision-making using defined labeled data. These algorithms are trained using a training set of labelled data. The method is supervised to look for patterns within the value labels supplied to data points. There is no correlation between the labels and the data points in unsupervised learning. Classification of data is accomplished through the use of unsupervised learning techniques. These algorithms categorize data. Unsupervised learning is also advantageous for conducting in-depth data analytics. Reinforcement learning algorithms choose an action based on each input point and then assess the quality of the decision. With time, the algorithm modifies its method to maximize performance and accuracy while also improving its learning. The efficient model is required to detect the complications occurs due to the diabetes in the health care management systems.

The Present invention, referring to Figure 1, illustrates a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early.

There are some technologies developed for detecting the occurrence of diabetes in the patients and the type of disease that a patient experiences in diabetes. But prediction and the method is different than the invention disclosed herein. Some of the work listed in the prior art is as follows:

WO/2020/211592 - *Diabetes Risk Early-Warning System,* presents “A diabetes risk early-warning system. Said system comprises: a storage device; and a first processor (1) based on improved k-means clustering, the first processor being coupled to the storage device and configured to: select a first clustering center point; and obtaining each stable cluster center on the basis of the first clustering center point, and substituting same into a diabetes piecewise function to obtain an early-warning model of diabetes, wherein a data set is selected, the number k of clustering clusters and a domain radius ε are

defined, and a point with the maximum sum of distances between a sample point Xi and a sample is selected as a first clustering center point, so that the first clustering center point falls at the center of each cluster. The system improves a clustering center method, establishes a diabetes piecewise function early-warning model, improves the diabetes early-warning capacity, and provides a basis for the diagnosis and treatment of diabetes at different stages. In addition, starting from the features of a diabetes data set, key feature variables of diabetes are filtered and selected, so that a diabetes prediction model is simplified, and the accuracy of the diabetes prediction model is improved, thereby helping to provide accurate diabetes prevention and treatment measures."

WO/2020/181805 - *Diabetes Prediction Method and Apparatus, Storage Medium, and Computer Device,* states*"* the present application discloses a diabetes prediction method and apparatus, a storage medium and a computer device, relating to the field of computer technology, being able to effectively solve the problem in the prior art that it can only be determined whether a user suffers from diabetes, but the severity of the disease thereof cannot be determined. Said method comprises: acquiring sample user data from original health profile and electronic medical record data; creating, according to user features in the sample user data, a regression prediction model of a numerical type; determining, using the regression prediction model, a first physical examination index value of fasting blood glucose of a target user and a second physical examination index value of blood glucose within a pre-set time period after a meal; and determining, according to the first physical examination index value and/or the second physical examination index value, the disease severity of the target user. The present application is applicable to the prediction of diabetes, and to the determination of the severity of diabetes."

US20200348316 - The present disclosure is related to the field of diabetes diagnostics. It introduces novel biomarkers that can be used to predict diabetes and detect presence of the disease. In addition, novel fatty acid biomarkers are presented."

US20160357934 - *Diabetes Onset and Progression Prediction using a Computerized Model,* states "The disclosed computerized system and method facilitates predicting the onset of diabetes or symptom progression in those patients already suffering from the disease. The computerized system and method applies steps to segment the population by predefined member characteristics. Once segmented, the computerized system and method applies a plurality of prediction models to the segmented population data to

provide a ranking of members of the population that indicates the likelihood of onset or progression of diabetes for each member."

EP3567594 – *Diabetes Management System with Dynamic Selection of Prediction Logic,* states "The invention relates to a system(100) for diabetes disease management. The system comprises a portable computing device (102, 174, and 176) with a client application (114) and a server computer (150). The portable computing device is operatively coupled to data collection units (134, 136, 140, 132, 142; 192, 194, 196; 182, 184, 186, 190) configured to collect data of a diabetes patient. The server computer (150) comprises a server application (164) implementing a plurality of prediction logics (116, 118, 120, 170, 172) configured for remotely computing a prediction (123) of a future physiologic state or a treatment suggestion for the patient. The server application is configured for receiving (322) current patient data (124) from the client application; identifying (324) the one or more data collection units having collected the current patient data; automatically identifying (326) one out of the plurality of prediction logics as a function of at least the number and type of the identified one or more data collection units; applying (328) the identified prediction logic at least on the received current patient data and on a history of the patient's patient data for computing the prediction; and returning (330) the prediction to the client application via the network."

Groupings of alternative elements or embodiments of the invention disclosed herein are not to be construed as limitations. Each group member can be referred to and claimed individually or in any combination with other members of the group or other elements found herein. One or more members of a group can be included in, or deleted from, a group for reasons of convenience and/or patentability. When any such inclusion or deletion occurs, the specification is herein deemed to contain the group as modified thus fulfilling the written description of all related groups used in the appended claims.

The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF INVENTION

The Present invention, referring to Figure 1, illustrates a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep

Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early, in accordance with main exemplary embodiment of the present disclosure.

The EDCLM model is implemented by receiving data, characterizing an excel in a tabular format. The system can accept data from diabetic and non-diabetic people. The EDCLM model is configured to take only tabular data as input. The excel document is used to establish the tabular format. The model generates output for diabetic risk classification solely from the input data set. Three phases are involved in the execution of the EDCLM model. The first phase would be to execute a few algorithms defined in the hybrid genetic algorithms; the second phase would be to execute the proposed novel deep learning algorithm; and finally, the remaining algorithms defined in the genetic algorithm would be executed. In the first phase, initialization heuristics, genetic sharp, local optimization algorithms would be executed. In the second phase, the proposed deep learning consists of a novel Deep Neuro Fuzzy classifier will be executed. In the third phase, novel crossover and prediction algorithms are executed to identify the early diabetic Complications Prediction. To evaluate the suggested new model, diabetes patient data was analyzed. The data revealed that the proposed model is capable of providing early diabetic Prediction depending on the patient's health. The first phase would be to execute a few algorithms defined in the Hybrid Genetic Algorithm-1 (104) comprising of: Initialize Heuristic, Genetic Sharp, and Local Optimization. Initialize the population using a known heuristic for the problem in the Initialize Heuristic Algorithm. It has been observed that initializing the entire population with a heuristic is not recommended, as this can result in the population having very similar solutions and little diversity. Thus, with the Initialize Heuristic Algorithm we would seed only a part of the population. The Genetic Sharp algorithm is used to eliminate incorrectly positioned and identified health conditions.

By validating all possible arrangements, the local optimization selects the health condition's sequences from the SEQLIST and arranges them in such a way that the most prominent sequences are ordered in descending order. The Hybrid Deep Learning System (105) comprising of: Fuzzification; Deep Learning Model; Rule Base; Inference; and Defuzzification is used in second phase. Fuzzification, deep learning, rule base, inference, and defuzzification are the five major components of the hybrid

deep learning system. To generate the output, each component must be executed in sequence. The components are not configured to alter the execution sequence. The Fuzzification step fine-tunes the data obtained from the hybrid genetic algorithm and converts the input values to linguistic variables for processing. Fuzzification is a multi-layer process that generates membership degrees at each layer. This model employs a hybrid membership degree algorithm. The membership algorithm is based on the combination of trapezoids and the Gaussian function. This system component generates an output that is used as an input in the subsequent step. This system's deep learning model is a hybrid one that combines Convolutional Neural Network and long short-term memory models. Convolutional and recurrent layers are combined in the hybrid deep learning model. Three levels comprise the hybrid deep learning model. The first level consists of each convolutional and recurrent layer's output layers. The second level is composed of various layers for convolutional and long short-term models, while the final level is composed of neuron dropout. Each convolutional layer performs batch normalization, ReLU, and max pooling, while the recurrent layers identify the necessary data. The rule base component contains all of the rules necessary to operate the system in order to produce the desired output. The rule base is comprised of the knowledge necessary for diabetic prediction and classification. It entails knowledge with both type 1 and type 2 diabetics. The system then passes the data to an inference component for further processing. The inference component is used to optimize the output generated by rule base execution in conjunction with the output of the deep learning model. Finally, the data would be processed in the hybrid deep learning model system's defuzzification component. The defuzzification component classifies and predicts early diabetics using the type-1 Mamdani inference system. The defuzzification component generates output depending on the fuzzy rules in the network. The defuzzifer generates output based on the network's fuzzy rules. The parameters for the rules are determined during the model's training phase. Following the defuzzification process, the output of the entire network is calculated. The system updates the parameters, weights, and parameters as necessary to achieve the desired accuracy. The Hybrid Genetic Algorithm-2 (106) comprising of: Crossover; and Prediction is performed in third phase.

A modified N-Point crossover is used to create an offspring that inherits the maximum amount of information possible from the chosen parents. In this crossover algorithm, two randomly chosen points on the individual chromosomes (strings) are used to exchange genetic material. The selection of the health condition from the partial

predictive list from the hybrid deep learning model introduces the greedy heuristic in the crossover algorithm. The prediction algorithm retains all of the Crossover algorithm's responses and then modifies them based on the parents chosen and the accuracy of the selected health conditions. Random resetting is used in the prediction algorithm from the set of permissible values assigned to the randomly selected parents. This algorithm aids in the early detection of diabetics based on a patient's health status.

BRIEF DESCRIPTION OF SYSTEM

The accompanying drawings are integrated into and form part of this specification to enable a better understanding of the invention described here. The drawing depicts exemplary embodiments of the present disclosure and, in conjunction with the description, helps to explain the principles of the disclosure. The drawings are for illustration purposes only and are not intended to limit the scope of the disclosure. To better understand the innovation, the accompanying drawings are used and are incorporated into this specification. The accompanying drawings are included. The drawing shows the exemplary extent of the current disclosure and helps to understand its principles when viewed in conjunction with the explanation. The drawings are only for illustrative purposes and do not in any way limit the extent of the information. Elements that use the same reference numbers are comparable but not identical. In order to define relative components, different reference numerals can, on the other hand, be used. Some embodiments may be lacking of such parts and/or components, while others may make use of elements or components not shown in the drawings.

The Present invention, referring to Figure 1, illustrates a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early, in accordance with main exemplary embodiment of the present disclosure.

Referring to Figure 2, illustrates Fundamental steps of proposed Model comprising of: Initialize (201); Genetic Sharp and Local Optimization Algorithms (202); Fuzzification (203); Deep Learning Model (204); Rule Base, Inference, and Defuzzification (205);

Crossover (206); Prediction (207); provides the overall steps involved in the proposed model of the invention, in accordance with another exemplary embodiment of the present disclosure.

Referring to Figure 3, illustrates Error rate in the proposed invention for the Dataset5 (242344 Records), in accordance with another exemplary embodiment of the present disclosure.

DETAIL DESCRIPTION OF THE SYSTEM

The invention will become more well-known as a result of the following extensive description, and objects other than those stated below will become apparent. The appended drawings are used in this description. The invention will become more well-known as a result of the following detailed description, and objects other than those described above will become obvious. This description pertains to the drawings that go along with the invention. In order to offer a complete understanding of embodiments of the current disclosure, certain specifics relating to various components and processes are provided. The information provided in the embodiments should not be construed as limiting the scope of this disclosure, as those skilled in the art will understand. The order of steps revealed in this invention's process and technique should not be interpreted as necessitating the order defined or represented. Alternatives or additional steps should also be considered. While the present invention is described herein using embodiments and illustrative drawings as examples, those skilled in the art will recognize that the invention is not limited to the embodiments or drawings described, and that they are not intended to represent the scale of the various components. The present invention herein is a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning is explored a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning is provided in the following layout that explains the entire view of the implementation of the invention that provides a multitask learning model for a healthcare systems to detect Diabetic Complication early.

The Present invention, referring to Figure 1, illustrates a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning

System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early, in accordance with main exemplary embodiment of the present disclosure. The EDCLM model is implemented by receiving data, characterizing an excel in a tabular format. The system can accept data from diabetic and non-diabetic people. The system then processed the obtained data using a hybrid genetic algorithm and a hybrid deep learning model to generate an output of diabetic risk profile complications from the input patient's data. The EDCLM model is configured to take only tabular data as input. The excel document is used to establish the tabular format. The model generates output for diabetic risk classification solely from the input data set. The diabetic risk classification prediction and classification are dependent on the provided data. The output generated by the processing system for a particular set of data might predict whether a patient is predisposed to diabetes or not, the amount of risk, and the type of diabetes depending on the patient's present health status. Three phases are involved in the execution of the EDCLM model. The first phase would be to execute a few algorithms defined in the hybrid genetic algorithms; the second phase would be to execute the proposed novel deep learning algorithm; and finally, the remaining algorithms defined in the genetic algorithm would be executed. In the first phase, initialization heuristics, genetic sharp, local optimization algorithms would be executed. In the second phase, the proposed deep learning consists of a novel Deep Neuro Fuzzy classifier will be executed. In the third phase, novel crossover and prediction algorithms are executed to identify the early diabetic Complications Prediction.

To evaluate the suggested new model, diabetes patient data was analyzed. The data revealed that the proposed model is capable of providing early diabetic Prediction depending on the patient's health. Once the model started (101), the patient data gathered (102) from the openly available dataset is purified (103) by removing unwanted noise present in the patient’s data. The first phase would be to execute a few algorithms defined in the Hybrid Genetic Algorithm-1 (104) comprising of: Initialize Heuristic, Genetic Sharp, and Local Optimization. Initialize the population using a known heuristic for the problem in the Initialize Heuristic Algorithm. It has been observed that initializing the entire population with a heuristic is not recommended, as this can result in the population having very similar solutions and little diversity. Thus, with the Initialize Heuristic Algorithm we would seed only a part of the population. The initialize heuristic algorithm works as below:

Initialize Heuristic Algorithm

Steps	**Algorithm**
1	Begin / Start
2	Select the patient's health condition with already identified as a Diabetic Patient
3	Identify the individual's health conditions that impact the identification of Diabetics. Move them to a List 'InitialHeuristicList'
4	From among the possible sequences find the sequence of most identified health conditions. Move them to a list 'TemporaryList'
5	Randomize the identified health conditions in the ''InitialHeuristicList'
6	Remove the head element of the 'InitialHeuristicList', compare with 'TemporaryList' elements and if found then insert into a 'FinalList' at the position where the sequence of health conditions is high else remove the condition from 'InitialHeuristicList'
7	Repeat step 6 until all the elements in the 'InitialHeuristicList' are moved to 'FinalList'
8	Stop

The Genetic Sharp algorithm is used to eliminate incorrectly positioned and identified health conditions. The Genetic Sharp algorithm works as below:

5 ***Genetic Sharp Algorithm***

Steps	**Algorithm**
1	Begin / Start
2	Create a list (SEQLIST) the contains all the list of possible sequence of health conditions
3	Create a list (HEALTHCONDITIONLIST) with the count of the individual health conditions for the whole population
4	For each health condition in HEALTHCONDITIONLIST: i.By comparing the health condition to the SEQLIST, eliminate the fewest ii.Repeat step i until all the elements in the 'HEALTHCONDITIONLIST are validated as single and in group
5	Stop

By validating all possible arrangements, the local optimization selects the health condition's sequences from the SEQLIST and arranges them in such a way that the most prominent sequences are ordered in descending order. The Hybrid Deep Learning System (105) comprising of: Fuzzification; Deep Learning Model; Rule Base; Inference; and Defuzzification is used in second phase. Fuzzification, deep learning, rule base, inference, and defuzzification are the five major components of the hybrid deep learning system. To generate the output, each component must be executed in sequence. The components are not configured to alter the execution sequence. The Fuzzification step fine-tunes the data obtained from the hybrid genetic algorithm and converts the input values to linguistic variables for processing. Fuzzification is a multi-layer process that generates membership degrees at each layer. This model employs a hybrid membership degree algorithm.

The membership algorithm is based on the combination of trapezoids and the Gaussian function. This system component generates an output that is used as an input in the subsequent step. This system's deep learning model is a hybrid one that combines Convolutional Neural Network and long short-term memory models. Convolutional and recurrent layers are combined in the hybrid deep learning model. Three levels comprise the hybrid deep learning model. The first level consists of each convolutional and recurrent layer's output layers. The second level is composed of various layers for convolutional and long short-term models, while the final level is composed of neuron dropout. Each convolutional layer performs batch normalization, ReLU, and max pooling, while the recurrent layers identify the necessary data. The rule base component contains all of the rules necessary to operate the system in order to produce the desired output. The rule base is comprised of the knowledge necessary for diabetic prediction and classification. It entails knowledge with both type 1 and type 2 diabetics. The system then passes the data to an inference component for further processing.

The inference component is used to optimize the output generated by rule base execution in conjunction with the output of the deep learning model. Finally, the data would be processed in the hybrid deep learning model system's defuzzification component. The defuzzification component classifies and predicts early diabetics using the type-1 Mamdani inference system. The defuzzification component generates output depending on the fuzzy rules in the network. The defuzzifer generates output based on

the network's fuzzy rules. The parameters for the rules are determined during the model's training phase. Following the defuzzification process, the output of the entire network is calculated. The system updates the parameters, weights, and parameters as necessary to achieve the desired accuracy. The Hybrid Genetic Algorithm-2 (106) comprising of: Crossover; and Prediction is performed in third phase. The Crossover Algorithm Works as below:

Crossover Algorithm

Steps	**Algorithm**
1	Begin / Start
2	Choose an initial Health condition from one of the randomly selected parents
3	Identify the health condition in the partial predictive list from the hybrid deep learning model
4	If the identified health condition is in the top list of the partial predictive list, then move the health condition to the preliminary predictive list
5	Remove the health condition from the selected parents list
6	Repeat step 1 to step 4 until all health conditions of the randomly selected parents are completed
7	Stop

A modified N-Point crossover is used to create an offspring that inherits the maximum amount of information possible from the chosen parents. In this crossover algorithm, two randomly chosen points on the individual chromosomes (strings) are used to exchange genetic material. The selection of the health condition from the partial predictive list from the hybrid deep learning model introduces the greedy heuristic in the crossover algorithm. The prediction algorithm retains all of the Crossover algorithm's responses and then modifies them based on the parents chosen and the accuracy of the selected health conditions. Random resetting is used in the prediction algorithm from the set of permissible values assigned to the randomly selected parents. This algorithm aids in the early detection of diabetics based on a patient's health status.

Referring to Figure 2, illustrates Fundamental steps of proposed Model comprising of: Initialize (201); Genetic Sharp and Local Optimization Algorithms (202); Fuzzification (203); Deep Learning Model (204); Rule Base, Inference, and Defuzzification (205);

Crossover (206); Prediction (207); provides the overall steps involved in the proposed model of the invention. Using the Initialize Heuristic Algorithm, initialize a subset of the population. Randomly initialize (201) the remainder of the population then Apply the Genetic Sharp algorithm (202) to all patient's health conditions of the initial population. After that apply the local optimization algorithm (202) to all the patient's health conditions of the initial population. Apply Fuzzification (203) to the received population from Step (202). Now apply Deep learning model (204) to the individual patient from Step (203). Initialize and instantiate Neuro fuzzy rule base (205) and then apply inference (205) for the individual patient's health condition.

Apply defuzzification of the patient and population received from Step (205). Repeat steps (203) to (205) until the end of specified number of iterations. At random, choose two parents and then apply Crossover Algorithm (206) between the parents and generate an offspring followed by Prediction (207) Algorithm for prediction. Repeat Steps (206) and (207) till criteria met or end of specified number of iterations. The present invention disclosed herein is evaluated on the openly available Diabetes Patient Datasets and the evaluation shows that the model in the proposed disclosure is capable of providing early diabetic Prediction depending on the patient's health. The model in the disclosure provided 94.1458% of Accuracy, 94.2327% of Specificity and 94.0126% of Sensitivity for patient dataset over 242344 records.

Referring to Figure 3, illustrates Error rate in the proposed invention for the Dataset5 (242344 Records). The error rate of the proposed model in the invention disclosed herein is decreasing when the number of epochs is increasing.

Results: The experiments were performed on the EDCLM model using diabetic patient's data set. The model is evaluated with ANFIS, Deep learning and XGBoost. The simulation is carried out in Python, Anaconda environment which runs on Windows 10 PC, Intel Core I7 processor with 64GB of RAM. The models are trained and tested in a sequential way by increasing the number of the datasets. The experiments were carried over is using 5000, 50000,100000,200000 and 242344 data records. According to the results presented in Table-1, it can be concluded that the accuracy of the proposed EDCLM model is better than the other algorithms. Accuracy comparison of proposed EDCLM Model with other Model is listed in below Table-1 shows that the proposed model has greater accuracy among other models.

TABLE-1

Accuracy comparison of proposed EDCLM Model with other Models

Dataset with Records	Accuracy			
	EDCLM Model	ANFIS	Deep learning	XGBoost
Dataset1 (5000 Records)	88.56%	84.43%	79.20%	83%
Dataset2(50000 Records)	89.73%	85.20%	81.24%	75.30%
Dataset3(100000 Records)	90.22%	86.31%	78.60%	84.80%
Dataset4(200000 Records)	93.38%	88.40%	87.76%	83.40%
Dataset5(242344 Records)	94.15%	89.21%	88.60%	82.34%

The EDCLM model may be beneficial in assisting healthcare professionals in identifying diabetic risks by complication. The EDCLM takes a variety of health conditions and provides a patient's early diabetes risk factor.

Physician enters the below data:

Enter Patient Age: 35

Enter Patient Sex:(M/F/N)- (1/2/3): 1

Enter Gestational Diabetes Status:(Y/N) -(1/2):1

Enter High blood pressure: 140

Enter Patient Height (cms): 173

Enter Patient Weight (kgs):90

Enter Patient Cholesterol level:(Low/Medium/High): High

Enter Patient high-density lipoprotein:(Low/Medium/High): Low

Enter Diabetic status:(Y/N) -(1/2):2

Enter obesity status:(Y/N) -(1/2):1

Enter patient's family Diabetic Status: (Y/N) -(1/2):1

Enter patient physical activities Status – (No Activity/Medium Activity/High activity) (1/2/3: 1

Enter patient Smoking Status:(Y/N) -(1/2):1

Enter patient Drinking Status:(Y/N) -(1/2):1

The predicted Risk factors could be: Diabetic Retinopathy – High Risk, Type -2 Diabetic – High Risk.

In order to provide a more detailed understanding of embodiments of the invention, some specific details are set out in the above exemplary description. An ordinary skilled

person, on the other hand, might recognize that the existing innovation can be implemented without including any of the specific data presented here. The major embodiment of the present disclosure is to provides a multitask learning model for a healthcare systems to detect Diabetic Complication early. For detecting complications associated with diabetic disease, further hybrid genetic and deep learning models are presented in the current disclosure. The subsequent description gives the details about the various components and methods used. To get better prediction, the method and the way of the present embodiment is provided in the above layout and it shall not limit the scope of the present disclosure.

Meka James Stephen

Digitally signed by Meka James Stephen
Date: 2021.09.28 16:08:49 +05'30'

CLAIMS

We claim:

1. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early and is used to construct risk profiles for a patient's health condition using a hybrid of genetic algorithms and deep learning models.

2. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the initial filter is the first component; the convolution and merge filter are the second component; and the classification or prediction filter is the third component.

3. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the model's hybrid genetic algorithms component executes in two phases; phase one being the initial filters and phase two receives the data from the deep learning model component and finally produces the classification or prediction.

4. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the model's hybrid genetic algorithms component's first phase consists of three novel algorithms – Initialize Heuristic, Genetic Sharp and Local optimization.

5. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the model's hybrid genetic algorithms component's second phase consists of two novel algorithms – Crossover and Prediction.

6. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the model's Hybrid Deep Learning component consists of five components Fuzzification, deep learning, rule base, inference and defuzzification.

7. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid

Genetic Algorithms and Deep Learning as claimed in claim 1, wherein to generate the output, the Hybrid Deep Learning components must be conducted in succession. The components are not configured to alter the execution sequence.

8. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the deep learning model in the Hybrid Deep Learning component is a hybrid deep learning models consists of Convolutional Neural Networks and long short-term memory models. The deep learning model combines the Convolutional and recurrent layers.

9. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the first level contains the output layers of each convolutional and recurrent layer. The second level has several layers for convolutional and long short-term models, while the final level contains neuron dropout.

10. A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning as claimed in claim 1, wherein the present invention disclosed herein is evaluated on the openly available Diabetes Patient Datasets and the evaluation shows that the model in the proposed disclosure is capable of providing early diabetic Prediction depending on the patient's health. The model in the disclosure provided 94.1458% of Accuracy, 94.2327% of Specificity and 94.0126% of Sensitivity for patient dataset over 242344 records.

Dated this 28th day of September, 2021

Meka James Stephen

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Date: 2021.09.28 16:08:25 +05'30'

A NOVEL EARLY DIABETIC COMPLICATION LEARNING MODEL (EDCLM) USING HYBRID GENETIC ALGORITHMS AND DEEP LEARNING

ABSTRACT

Diabetes is now one of the world's most common, chronic, and deadly diseases due to its complications. Diabetes detection at an early stage is essential for timely treatment because it can stop disease progression. A model that can predict the occurrence of diabetes in the future but also determine the type of disease that a person experiences in diabetes is required. The present invention disclosed herein is a Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning comprising of: Hybrid Genetic Algorithm-1 (104); Hybrid Deep Learning System (105); and Hybrid Genetic Algorithm-2 (106); provides a multitask learning model for a healthcare systems to detect Diabetic Complication early. The model can be implemented in three phases in which Hybrid Genetic Algorithm-1 (104) comprising of: Initialize Heuristic, Genetic Sharp, and Local Optimization is performed in first phase; the Hybrid Deep Learning System (105) comprising of: Fuzzification; Deep Learning Model; Rule Base; Inference; and Defuzzification is used in second phase; the Hybrid Genetic Algorithm-2 (106) comprising of: Crossover; and Prediction is performed in third phase. The present invention disclosed herein is evaluated on the openly available Diabetes Patient Datasets and the evaluation shows that the model in the proposed disclosure is capable of providing early diabetic Prediction depending on the patient's health. The model in the disclosure provided 94.1458% of Accuracy, 94.2327% of Specificity and 94.0126% of Sensitivity for patient dataset over 242344 records.

Dated this 28th day of September, 2021

Meka James Stephen

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Date: 2021.09.28 16:08:05 +05'30'

DRAWINGS

Total No of Sheets: 2

Sheet No.1

Applicants: Prof. James Stephen Meka, Mr.K.Nani Kumar, and Prof. Prasad Reddy P.V.G.D.

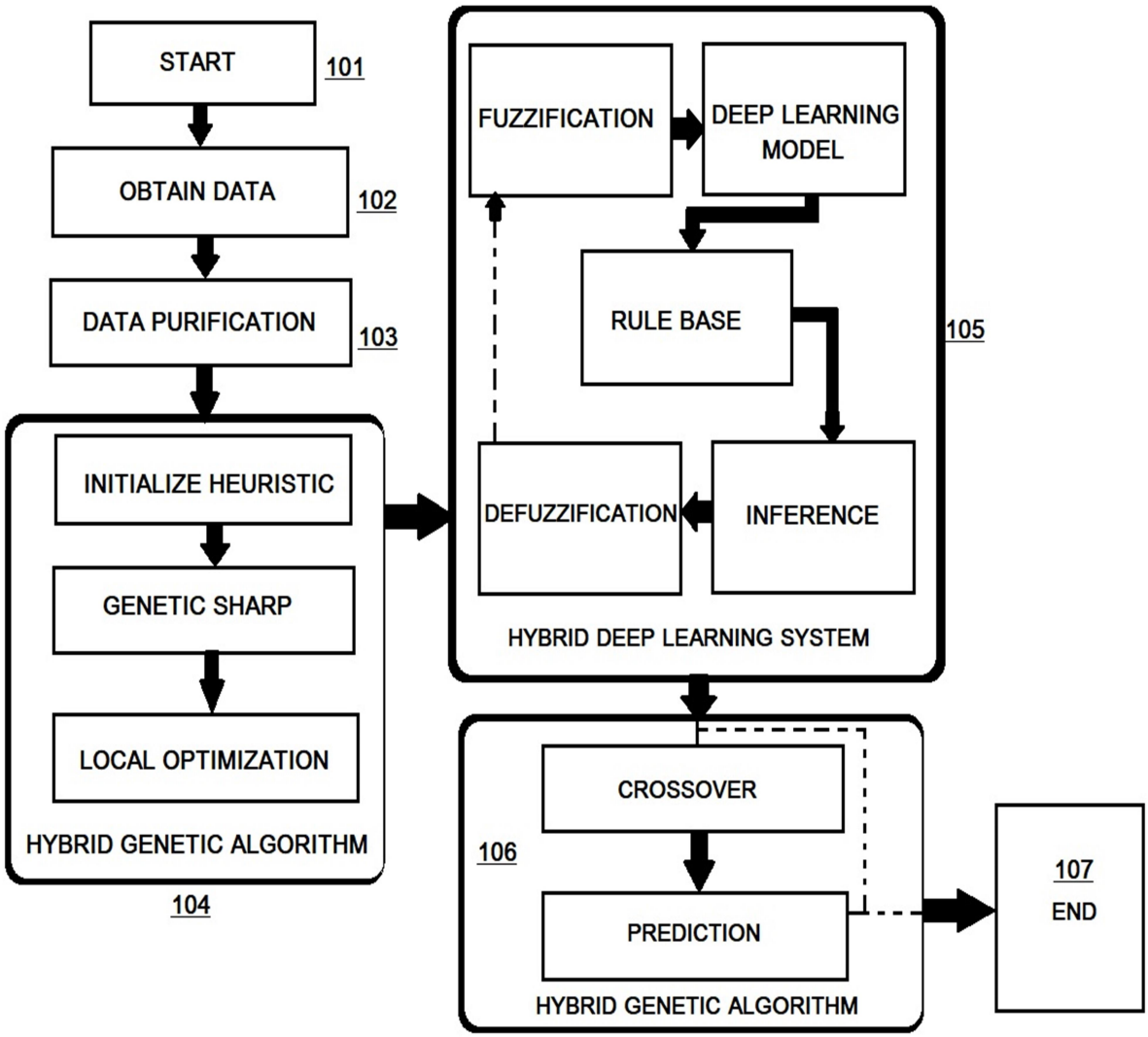

FIGURE 1: A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning.

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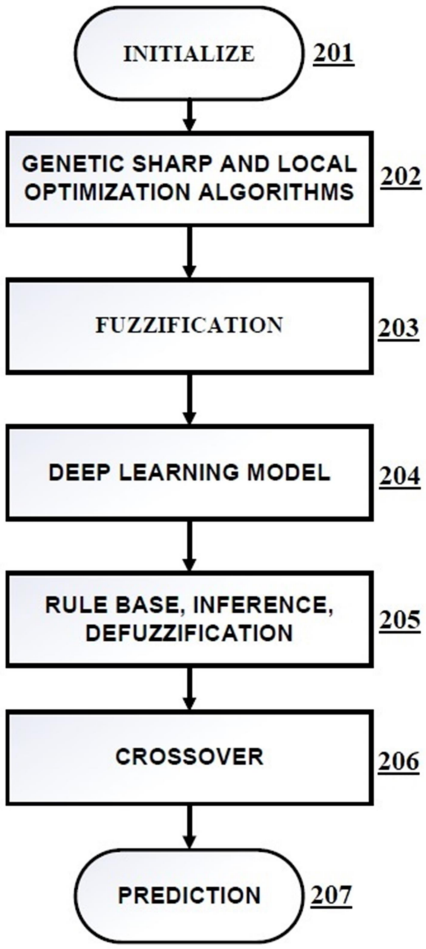

FIGURE 2: Fundamental steps of proposed Model.

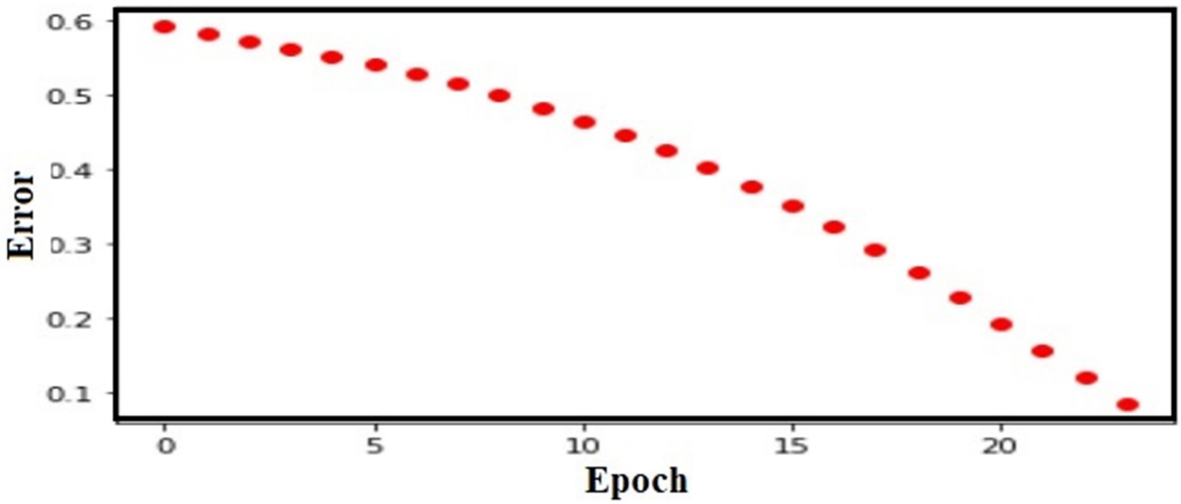

FIGURE 3: Error rate in the proposed invention for the Dataset5 (242344 Records).

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Date: 2021.09.28 16:09:33 +05'30'

FORM 9

THE PATENT ACT, 1970
(39 of 1970)
&
THE PATENTS RULES, 2003

REQUEST FOR PUBLICATION

[See section 11A (2); rule 24A]

I/We **Prof. James Stephen Meka, Mr.K.Nani Kumar, and Prof. Prasad Reddy P.V.G.D.** hereby request for early publication of my/our application for patent, titled "**A Novel Early Diabetic Complication Learning Model (EDCLM) using Hybrid Genetic Algorithms and Deep Learning**" dated 28-09-2021, under section 11A(2) of the act.

Dated this 28th day of September, 2021 **20:00:00** under section 11A (2) of the Act.

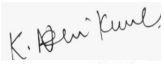
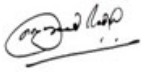
1. Name, Nationality and address of Applicants:

Sr.No	Name	Nationality	Address	Country	State
1	Prof. James Stephen Meka	Indian	Professor, Department of CSE, WISTM Engineering College, Pinagadi (V), Pendurthi (M), Visakhapatnam, Andhra Pradesh, India. Pin Code: 531173	India	Andhra Pradesh
2	Mr.K.Nani Kumar	Indian	Research Scholar, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh
3	Prof. Prasad Reddy P.V.G.D.	Indian	Senior Professor, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh

~~**2. To be signed by the applicant or authorized registered patent**~~

Dated this 28th day of September, 2021

3. Name of Applicant(s)/ Inventor(s) Signature(s):

Name of the natural person who has signed.	Signature:-
Prof. James Stephen Meka	
Mr.K.Nani Kumar	
Prof. Prasad Reddy P.V.G.D.	

To

The Controller of Patents

The Patent office at CHENNAI

FORM 3

THE PATENTS ACT, 1970
(39 of 1970)
and
THE PATENTS RULES, 2003

STATEMENT AND UNDERTAKING
UNDER SECTION 8

(See section 8; Rule 12)

1. Name of Applicant(s):
Prof. James Stephen Meka, Mr.K.Nani Kumar, and Prof. Prasad Reddy P.V.G.D.

2. Name, Address and Nationality of the Applicant(s):

Sr.No	Name	Nationality	Address	Country	State
1	Prof. James Stephen Meka	Indian	Professor, Department of CSE, WISTM Engineering College, Pinagadi (V), Pendurthi (M), Visakhapatnam, Andhra Pradesh, India. Pin Code: 531173	India	Andhra Pradesh
2	Mr.K.Nani Kumar	Indian	Research Scholar, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh
3	Prof. Prasad Reddy P.V.G.D.	Indian	Senior Professor, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh

I/We, Prof. James Stephen Meka, Mr.K.Nani Kumar, and Prof. Prasad Reddy P.V.G.D., is/are the true & first inventor(s) for this invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(i) that I/We have not made any application for the same/substantially the same invention outside India.

OR

~~(ii) that I/We who have made this application No…….dated ……..alone/jointly with……., made for the same/substantially same invention, application(s) for~~

~~patent in the other countries, the particulars of which are given below:~~

Name of the country	Date of application	Application No.	Status of the application	Date of publication	Date of grant

~~3.Name and address of the assignee~~	(iii)that the rights in the application(s) has/have been assigned to…….. that I/We undertake that upto the date of grant of the patent by the Controller, I/We would keep him informed in writing the details regarding corresponding applications for patents filed outside India within six months from the date of filing of such application. Dated this: 28th September, 2021
4. To be signed by the applicant or ~~his authorized registered patent agent.~~	Signature:…… Prof. James Stephen Meka Mr.K.Nani Kumar Prof. Prasad Reddy P.V.G.D.

5. Name of the natural person who has Signed.	Prof. James Stephen Meka Mr.K.Nani Kumar Prof. Prasad Reddy P.V.G.D.

To

The Controller of Patents

The Patent office at CHENNAI

FORM 5

THE PATENT ACT, 1970

(39 OF 1970) &
The Patent Rules, 2003

DECLARATION AS TO INVENTORSHIP

[See sections 10(6) and Rule 13(6)]

1. NAME OF APPLICANT(S):

Sr.No	Name	Nationality	Address	Country	State
1	Prof. James Stephen Meka	Indian	Professor, Department of CSE, WISTM Engineering College, Pinagadi (V), Pendurthi (M), Visakhapatnam, Andhra Pradesh, India. Pin Code: 531173	India	Andhra Pradesh
2	Mr.K.Nani Kumar	Indian	Research Scholar, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh
3	Prof. Prasad Reddy P.V.G.D.	Indian	Senior Professor, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh

I/We Prof. James Stephen Meka, Mr.K.Nani Kumar, and Prof. Prasad Reddy P.V.G.D.., hereby declare that the true and first inventor(s) of the invention disclosed in the complete specification filed in pursuance of my/our application numbered…….dated is/are:

2. INVENTOR(s):

Sr.No	Name	Nationality	Address	Country	State
1	Prof. James Stephen Meka	Indian	Professor, Department of CSE, WISTM Engineering College, Pinagadi (V), Pendurthi (M), Visakhapatnam, Andhra Pradesh, India. Pin Code: 531173	India	Andhra Pradesh
2	Mr.K.Nani Kumar	Indian	Research Scholar, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh
3	Prof. Prasad Reddy P.V.G.D.	Indian	Senior Professor, Department of CS & SE, A.U. College of Engineering (A), Andhra University, Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003	India	Andhra Pradesh

Dated this…28th day of September, 2021

Name of the Signatory Signature:-

Prof. James Stephen Meka

Mr.K.Nani Kumar

Prof. Prasad Reddy P.V.G.D.

3. DECLARATION TO BE GIVEN WHEN THE APPLICATION IN INDIA IS FILED BY THE APPLICANT (S) IN THE CONVENTION COUNTRY:-

~~We the applicant(s) in the convention country hereby declare that our right to apply for a patent in India is by way of assignment from the true and first inventor(s).~~

~~Dated this ……day of 2020~~

~~Signature:-~~

~~Name of Signatory:-~~

4. STATEMENT ~~(to be signed by the additional inventor(s) not mentioned in the application form)~~

~~I/we assent to invention referred to in the above declaration, being included in the complete specification filed in pursuance of the stated application.~~

~~Dated this …….day of 2020~~

~~Signature of the additional inventor (s)~~

~~Name :~~

To

The Controller of Patents

The Patent office at CHENNAI