International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 21 (2017) pp. 11727-11737

Analysis of Different Methods for Identification and Classification of Cervical Spondylosis (CS): A Survey

Pankaj Pramod Chitte
Research Scholar, Department of Electronics & Telecommunication Engineering,
G.H. Raisoni College of Engineering, Nagpur, Maharashtra, India.

Dr. Ulhaskumar M. Gokhale
Dean R & D, G. H. Raisoni Institute of Engineering and Technology, Nagpur,

[1]Orcid: 0000-0003-4975-886X

Abstract
In this paper we have compared different methods of Cervical Spondylosis detection. There are various measuring tools to evaluate the neck pain, regional pain, neurologic deficits of the sphincters, torso caused by Cervical Spondylosis. However, the results are challenged because Cervical Spondylosis can be subdivided into different sub-types due to different pathological diagnosis. After comparison we have found that for the analysis of Cervical Spondylosis (CS) detection requires an extensive knowledge of the anatomy, skill and experience of specialist. We also found one interesting thing that Doctors are doing manual inspection by using MRI and CT scans. There is no automatic method available so we propose the system which can automatically detect and analyses the Cervical Spondylosis using CNN-LSTM algorithm.

The Long Short-Term Memory (LSTM) and the Convolutional Neural Networks (CNNs) is an algorithm to make automation in various real life applications by using machine learning methodology. This architecture includes utilizing Convolutional Neural Network (CNN) layers for highlight extraction on input information joined with LSTMs to help grouping expectation which gives higher accuracy in classification and detection of disease from MRI images. A CNN LSTM can be characterized by including CNN layers in front end and LSTM layers in back end.

We had also analyzed various dataset and its results obtained in many existing research work and made comparative study in automation techniques, also proposed our system for making automation efficiently and found that we can improve the detection accuracy significantly.

keywords: Cervical Spondylosis *(*CS); regions of interest (ROI); computed tomography (CT); Magnetic resonance imaging (MRI); convolutional neural network long short-term memory (CNN-LSTM).

INTRODUCTION

Cervical Spondylosis also known as Cervical osteoarthritis in neck. It is due to the wear and tear of the tendon and bones found in your cervical spine, which is in your neck. While it's to a great extent because of age, it can be caused by different factors also.

The spinal cord is made up of anterior gray matter, lateral white matter, and posterior grey and white matter. Lower motor neuron bodies make up the anterior gray matter, while the descending cortico spinal tracts and the pain and temperature fibres of the spinothalamic tract run in the lateral white matter. Cell bodies of first order sensory neurons make up the dorsal grey matter while the dorsal white matter contains some of the axons of proprioceptive, vibratory, and touch sensory neurons.MRI is currently broadly recognized as the imaging methodology of decision to demonstrate diseases and abnormalities of the spinal column and the intervertebral discs [26].

The Cervical spine has the most spinal mobility with as much as 600 movements per hour in an ordinary individual, accordingly its high weakness to degenerative changes [6][7].Magnetic resonance imaging (MRI) or computed tomography (CT) can confirm the conclusion. MRI gives much more information because it shows the spinal cord and roots. However, the two techniques demonstrate where the spinal channel narrowed, how compressed the spinal cord is, and which spinal nerve roots may be influenced.

Cervical Spondylosis can introduce itself in a large number of ways. It can often be asymptomatic; it can cause neck pain, regional pain, and can cause neurologic deficits of the sphincters, middle, or the furthest points if there is spinal cord contribution [5]. In the majority of cases patients between the ages of 40 and 60, with men being more regularly are influenced than ladies at a proportion of 3: 2, Factors other than maturing can build your danger of Cervical Spondylosis. These include:

- Neck injuries.
- Work-related exercises that put additional strain on your neck from hard work.
- Holding your neck in an uncomfortable position for prolonged periods of time or repeating similar neck developments for the duration of the day (repetitive stress).

- Family history of Cervical Spondylosis (Genetic factors).
- Smoking.
- Being overweight and dormant.

The vast majority with Cervical Spondylosis don't have critical manifestations. In the event that indications do happen, they can go from mild to serious and may develop well-ordered or happen all of a sudden. One fundamental reaction is torment around the shoulder bone. Patients will complain of pain along the arm and in the fingers.

The pain might increase in below position of human body

- Standing
- Sitting
- Sneezing
- Coughing
- Tilting your neck in reverse

Other basic signs include:

- A stiff neck that becomes worse.
- Headaches that mostly occur in the back of the head.
- Muscle weakness makes it difficult to lift the arms or handle objects firmly.
- Tingling or deadness that basically influences shoulders and arms, in spite of the fact that it can likewise happen in the legs.
- Symptoms that happen less frequently often include a loss of balance and a loss of bladder or bowel control.

Spondylosis is for the most part assembled by these three clinical issue or techniques for presentation introduction axial neck pain, Cervical radiculopathy, and Cervical myelopathy. Mix of any of the three issues. Confirmation of spondylotic change is much of the time found in numerous asymptomatic adults [1], with 25% of adults under the age of 40, 50% of adults over the age of beyond 40 and 85% years old, of grown-ups beyond 60 years old demonstrating some proof of disc degeneration [2, 3].

Another investigation asymptomatic adult showed significant degenerative changes at least 1 levels in 70% of ladies and 95% of men at age 65 and 60 [4]. The most understood confirmation of degeneration is found at C5-6 took after by C6-7 and C4-5 [3]. Treatment for mild and moderate disease is normally conservative with surgical mediation prompted for those with extreme intractable pain, progressive disease, and for those with associated weakness and neurological deficits.

Then C. Green et al. highlight the central role of diagnostic imaging in clinical diagnosis and preoperative planning. From this paper we became aware thatMagnetic resonance imaging (MRI) provides the greatest range of information compared with other radiological studies available to evaluate the spine. It provides an accurate morphological assessment of both bony and soft tissue structures including intervertebral discs, spinal ligaments, and the neural elements [12].

1. THE ANATOMY

- There are 7 vertebrae (bones) in the neck [33].
- Together they form the upper-most section of the vertebral column which is known as the "Cervical spine".
- They are labelled C1 to C7 with C1 at the top and C7 furthest from the head and adjoining the first vertebra of the next section of the spine.
- Only two of the vertebrae of the Cervical spine also have individual names. They are C1 which is called the "Atlas" bone and C2 which is called the "Axis" bone.

Sr. No.	Neck Pain cause / syndrome	Description / Explanation(s)
1	Postural neck pain	Postural neck pain refers to pain in the neck and shoulders caused or exacerbated by postural habits such as holding the head/neck/shoulders in fixed protracted positions for long periods of time
2	Acute neck pain (unknown cause)	In case a sudden advancement of the neck realizes extraordinary neck acknowledges uncommon neck torment possibly joined by arm torment, muscle fit and additionally constrained advancement of the neck then the issues settle itself without mediation or ID of the assistant reason.
3	Cervical Spondylosis	Cervical Spondylosis results from on-going 'wear and tear' of the Cervical vertebrae and the intervertebral discs that separate them in the neck.
4	Cervical myelopathy	Cervical myelopathy is due to pressure on the spinal cord leading to dysfunction of the

		nerves below the area of pressure. It is therefore a condition of the nerves (spinal cord).
5	Rheumatoid arthritis (in the neck)	When all is said in done this can bring about joints getting to be plainly difficult, swollen, and solid. Rheumatoid joint inflammation in the neck (Cervical spine) regularly includes the atlantoaxial joint which is the explanation between C1 (the "atlas" bone) and C2 (the "axis" bone).
6	Klippel-Feil Syndrome - Rare	In general, thoracic outlet syndrome can affects nerves, result in pressure on blood vessels - affecting circulation, and cause pain, tingling, swelling and/or weakness.
7	Thoracic outlet syndrome - Rare	The thoracic outlet is the area between the rib cage and clavicle bone (which is also commonly referred to as the "collar bone").
8	Neoplasms in the neck area - Rare	"Tumors starting in the Cervical spine (neck bones) are uncommon. At the point when tumors are found here they are frequently found to have begun somewhere else in the body and are accordingly said to be "auxiliary stores"
9	Osteitis in the neck area - Rare	Osteitis is a general term for aggravation of bone. Osteitis in the neck zone (called "Cervical spine osteitis") is remarkable, however not unfathomable, in many created countries.Osteitisa general term for irritation of bone is. Osteitis in the neck range (called "Cervical spine osteitis") is unprecedented, yet not incredible, in many created nations.

Table 1: Types of neck pain and its causes [33].

Based on above clinical study we have decided to make one of efficient technique to detect the disease in early stage to avoid further losses to human being in view of the same subject we had analysed various research paper and found many algorithm like KNN, Random Forest, KCCA etc. furthermore we had done result analysis to fix the proposed methodology and found CNN LSTM is most efficient algorithm which can give us satisfactory result. The detailed result analysis is elaborated in literature review.

LITERATUREREVIEW

In paper Classifying Cervical Spondylosis Based on Fuzzy Calculation, XinghuYu, Liangbi Xiang [12] analyzed that, In the Chinese analysis, clinical classification of the CS mostly includes four types: (i) CS radiculopathy (CSR), (ii) Cervical spondylotic myelopathy (CSM), (iii) vertebral artery type of CS (VACS), and (iv) sympathetic CS (SCS) [10]. Fuzzy logic has been ended up being a powerful tool as decision-making systems, for example, pattern classification systems and expert diagnostic platform [11]. Fuzzy logic theory has been utilized as a part of some medical expert systems for instance [12, 16].

S. D. Boden et al[4], found that Disc was degenerated, 25% of adults under the age of 40, 50% of adults over the age of 40, and 85% of adults over the age of 60. For this analysis The Author studied the magnetic resonance-imaging scans of sixty-three volunteers who had no history of symptoms indicative of Cervical disease. The scans were mixed randomly with thirty-seven scans of patients who had a symptomatic lesion of the Cervical spine, and all of the scans were interpreted independently by three Nero Radiologists and concluded that Disc was degenerated, 25% of adults under the age of 40, 50% of adults over the age of 40, and 85% of adults over the age of 60 [4].

The M.Matsumoto, Y. Fujimura, N. Suzuki et al[9] authors worked and gave the result the age-dependent occurrence of Cervical degenerative changes was studied using 0.1 T MRI in 89 asymptomatic volunteers aged 9 to 63 years [9] and they found abnormalities were commoner in older subjects, 62% of being seen in those over 40 years old. In subjects aged less than 30 years there were virtually no abnormalities.

In Cervical Spondylosis Evaluation of micro structural changes in spinal cord white matter and gray matter by diffusion kurtosis imaging paper the authors Masaaki Hori et al, utilized diffusional kurtosis imaging (DKI) calculation and the outcome got is taking all things together all patients, DKI data of good picture quality were effectively gotten. In addition, white matter tractography of the bilateral lateral funiculars was successful, and values for FA, ADC, and MK were acquired.

In Possible detection of Cervical spondylotic neuropathy using Distribution of F-latency (DFL) paper the authors Mohammad J Alam,Khondkar S Rabbani used Distribution of F-latency (DFL) algorithm and the result obtained is Double, (and sometimes triple) crests in the DFL were seen from the thinner muscle in numerous patients giving with symptoms

matching those of CS neuropathy. Additionally watched for the tibial and regular peroneal nerves of a few patients demonstrating a lumbo-sacral (LS) spondylotic neuropathy. Along these lines further examination concerning the utilization of DFL for both CS and LS neuropathy. Along these lines further examination concerning the utilization of DFL for both CS and LS neuropathy may lead to a new and simple diagnostic tool.

Authors Zhang Huiyu, GuoMinfang, Lu Xiaozuo used pulse acquisition device based on image (PADBI) algorithm used in paper Pulse changes in patients with Cervical Spondylosis before and after acupuncture treatment. The result obtained is PADBI can give confirmation to result expectation of needle therapy treatment in patients with CS. PADBI can offer verification to target assessment of acupuncture treatment of CS.

Magnetic resonance imaging technique used by the authors Mustapha Z et al, in paper Cervical Spine MRI Findings in Patients Presenting with Neck Pain and Radiculopathy and the result obtained is Magnetic resonance imaging is the most dependable strategy for assessing the spine and spinal string and remains the highest quality level. Degenerative changes are normal in this region and were appeared by this investigation to increments directly with age and influence different intervertebral circle levels

Below Table 2 represents Collated summary of the correspondence of DFL patterns with neurological condition in the Cervical region [18] used in paper "Possible detection of Cervical spondylotic neuropathy using Distribution of F-latency (DFL), a new neurophysiological parameter".

DFL pattern	No. of nerves	clinical condition	Comments
Double peak	4	Diagnosed CS	Double peak likely to represent CS, single case with pain possibly has CS
Double peak	1	Pain in shoulder, not yet gone for medical investigation	As above
Broa peak	2	With single peak of DFL on opposite side	Cases with CS on one side are more likely to develop CS on the opposite side. Broad peak may be an early indicator of CS
Broa peak	5	With double peak of DFL on opp. side, 4 with CS, 1 with pain in shoulder.	As above

Table 2: summary of the correspondence of DFL patterns with neurological condition in the Cervical region [18]

Beyrem Jebri et al [28], from University of Exeter, Devon, UK [28] tested his approach on a cohort of 103 patients, with ages ranging from 19 to 96 and having trauma or had symptoms requiring Cervical spine radiographs. The features was extracted over the part formed between vertebral body centres, i.e., C1/C2, C2/C3,....C5/C6 and presented in Table 3. The presence of degenerative change was provided by an expert radiographer, reinforced by radiological reports. As the results were produced using a leave-one-out cross validation, the values in the table show an average over 103 runs[28], each time holding one sample out, training and testing the classifier using the held-out sample. Random Forest had shown better performance compared to kNN in both the case of averaging and CS method. e.g. the sensitivity of detecting degenerative changes for the "C4/C5" part, the output demonstrate that averaging method accurately detects degenerate change, with more than 95% accuracy. In addition to detecting degenerative change, his algorithms also detects the superior & inferior edges of the vertebral bodies parts, the edges detected by his method can be utilised in a vertebral body segmentation algorithm.

Algo.	C1/C2	C2/C3	C3/C4	C4/C5	C5/C6	Parameter
Random Forest (avg. method)	96.8% 100% 95%	96% 100% 94.6%	96.1% 100% 95%	95.3% 98.7% 92.4%	98% 100% 97.3%	Accuracy Sensitivity Specificity
KNN (avg. method)	83.9%	84%	82.6%	71.3%	88%	Accuracy
Random Forest (CS method)	98.6% 100% 98%	94.4% 96.8% 93.5%	93.9% 94.6% 93.6%	94.2% 100% 88.9%	96.3% 100% 95.8%	Accuracy Sensitivity Specificity
kNN (CS method)	86.3%	79.2%	83.4%	80.2%	82.4%	Accuracy

Table 3: comparative study of various algorithms for Classification of detecting degenerative changes [28]

E. Clarke ,P. K. Robinson, longitudinally followed up 120 patients with Cervical Spondylosis myelopathy and a mean age of 53 years and detailed that in 75% of cases the ailment decayed in a roundabout way, in 20% of cases there was a relentless movement of indications, and in 5% of cases there was a quick beginning of manifestations took after by a long break in infection movement [6]. Now upto this we have collected data regarding aging effect on Cervical Spondylosis.

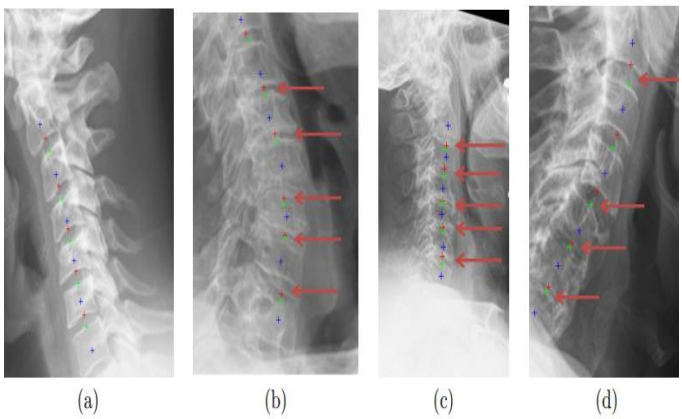

Figure 1: Detected parts with degenerative changes (arrows) along with superior (green) and inferior vertebral body edges. (a) Patient with no degenerative change is shown (b) and (c) the approach correctly identifies degenerative changes. (d) The method correctly identifies the degenerative change on the lower portion of the Cervical spine [28]

Lisa A. Ferrara, done review on Biomechanics of Cervical and found that by restoring the lordotic posture of the Cervical spine, the load balance is restored, where 80% of the axial transmitted along the ventral segment is adjusted at the IAR of the spinal section, adequately, stopping the movement of the decreased limited powers and worries at every spinal level and over the instrumentation, with lessened weights on each screw and over each join site for enhanced longterm obsession [11].

Regarding classification of Cervical Spondylosis in following paper Xinghu Yu et.al[14], tried to develop the traditional diagnosis method of Cervical Spondylosis is based on X-ray reading. However, some divergences often take place on the type classification for there exist some deficiencies in the definition of the X-ray, the experience of clinicians in X-ray reading and clinic work and so on. To cope with the matter, they put forward a method based on maximum likelihood theory to solve the type classification of Cervical Spondylosis in the article. they firstly established the X-ray quantitative diagnosis model according to analysis of 1034 clinical cases, and then carry it out with 60 cases of the test group. Although there is no statistically significant difference in the rate of diagnosis but slightly higher rate is observed in the aspect of accuracy when comparing the maximum likelihood method with a X-ray reading method 80.0% vs 68.3%, so the maximum likelihood method based on X-ray quantitative diagnosis is an efficient approach in the type classification of Cervical Spondylosis. Also in this paper they showed a completely preliminary improved maximum likelihood model to classify Cervical Spondylosis mainly depending on X-ray manifestations. They had collected lots of clinical cases and adopted many experts who were expert in orthopedics. In this way they not only allowed clinicians and radiologists making more precise decision but also can decrease the burden of their work. This paper is motivation for us but still from this method total automatic diagnosis is not possible [14].

We also survyed the paper on image processing like segmentation process, use of different filter for efficiant output. In this regard Shital V. Sokashe presented A PC helped strategy for the division of Cervical vertebrae from x-beam images.Segmentation of Cervical vertebrae in x-beam pictures is extremely useful for the bone morpho-metrists. Because of low dark level variety of x-beam pictures it is exceptionally hard to fragment the Cervical vertebrae, In this technique Shape inconstancy is found out through perception [15].

J. Preetha et.al[16], created better method for work presents a computer aided diagnostic system for automatic Cervical disc herniation classification. A multilevel set segmentation model with Zernike moments, segmenting Cervical discs is investigated for feature extraction. Chosen features are classified using Support Vector Machines (SVM) with Radial Basis Function (RBF) kernel. A Binary Artificial Bee Colony (BABC) is proposed to improve the efficiency of SVM by optimizing its parameters. they found that the proposed method improves the classification accuracy and it has problem of the underlying image signal is ambiguous. Even the structure changes from case to case, with possible spinal column bending (scoliosis).

CONVOLUTIONAL NEURAL NETWORKLONG SHORT-TERM MEMORY (CNN-LSTM)

The CNN LSTM for short is a LSTM engineering particularly planned for course of action estimate issues with spatial data sources, like pictures or chronicles. This includes utilizing Convolutional Neural Network (CNN) layers for highlight extraction on input information joined with LSTMs to help grouping expectation [36].

A CNN LSTM can be characterized by including CNN layers the front end took after by LSTM layers with a thick layer on the yield. It is useful to think about this engineering as characterizing two sub-models: the CNN Model for highlight extraction and the LSTM Model for deciphering the highlights crosswise over time steps [36].

CNN LSTMs were produced for visual time arrangement expectation issues and the use of creating printed portrayals from successions of pictures (e.g. recordings). In particular, the issues of

- **Activity Recognition**: Generating a literary portrayal of an action exhibited in an arrangement of pictures.
- **Image Description**: Generating a literary portrayal of a solitary picture.
- **Video Description**: Generating a textual description of a sequence of images.

Below figure 2 shows an example of a deep convolutional neural network to generate a victories representation of an image that we then feed into a Long-Short-Term Memory (LSTM) network, which then generates captions.

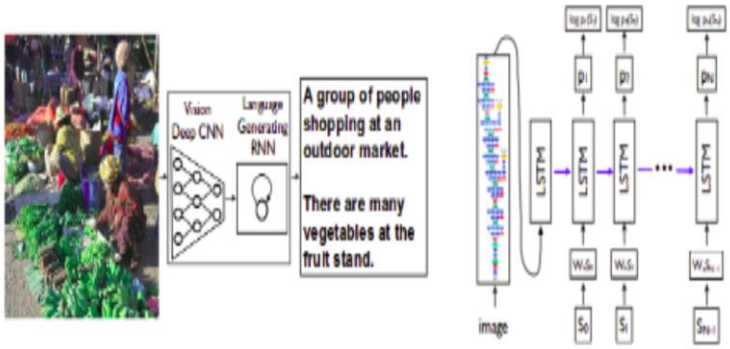

Figure 2: (Left) Our CNN-LSTM architecture, modeled after the NIC architecture described in [37].We use a deep convolutional neural network to create a semantic representation of an image, which we then decode using a LSTM network. (Right) An unrolled LSTM network for our CNN-LSTM model. All LSTMs share the same parameters. The victories image representation is fed into the, network, followed by a special start of sentence token. The hidden state produced is then used by the LSTM predict/generate the caption for the given image. [37]

1. THE CNN MODEL

In machine learning, a convolutional neural network (CNN or ConvNet) is a class of deep, feed-forward artificial neural networks that has successfully been applied to analyzing

visual imagery. CNNs use a variation of multilayer perceptrons designed to require minimal pre-processing [37]. They are otherwise called move invariant or space invariant counterfeit neural systems (SIANN), in view of their mutual weights engineering and interpretation invariance qualities. CNNs utilize moderately little pre-preparing contrasted with other picture grouping calculations. This implies the system takes in the channels that in conventional calculations were hand-built. A CNN comprises of information and a yield layer, and additionally various shrouded layers. The shrouded layers are either convolutional, pooling or completely associated [36].

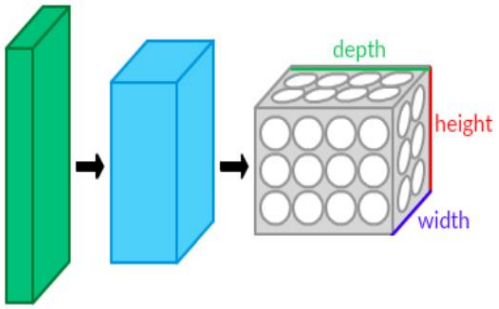

Figure 3: CNN layers arranged in 3 dimensions

While traditional multilayer perceptron (MLP) models were successfully used for image recognition, due to the full connectivity between nodes they suffer from the curse of dimensionality and thus do not scale well to higher resolution images [36].

FEATURES OF CNN

- **3D volumes of neurons,** the layers of a CNN have neurons arranged in 3 dimensions width, height and depth. The neurons inside a layer are associated with just a little district of the layer before it, called a receptive field. Distinct types of layers, both locally and completely connected, are stacked to shape a CNN design.
- **Local availability,** following the idea of local connectivity, following the concept of receptive fields, CNNs exploit Local availability, following the idea of "filters" deliver the most grounded reaction to a spatially neighbourhood input design. Stacking numerous such layers prompts non-direct "filters" that turn out to be progressively "global" (i.e. responsive to a larger region of pixel space). This enables the system to first make portrayals of little parts of the info, at that point from them gather portrayals of bigger zones.
- **Shared weights,** In CNNs, each filter is reproduced over the whole visual field. These duplicated units share a similar parameterization (weight vector and bias) and frame an element outline. This implies every one of the neurons in a given convolutional layer react to a similar component (within their specific response field). Replicating units in this way allows for features to be detected regardless of their position in the visual field, thus constituting the property of translation invariance.

Together, these properties enable CNNs to accomplish better speculation on vision issues. Weight sharing drastically lessens the quantity of free parameters adapted, in this manner bringing down the memory prerequisites for running the system. Diminishing the memory impression permits the preparation of bigger, all the more intense systems.

2. *THE CONVOLUTIONAL NETWORK*

The convolutional layer is the center building piece of a CNN. The layer's parameters comprise of an arrangement of learnable channels (or portions), which have a little open field, yet reach out through the full profundity of the info volume. Amid the forward pass, each channel is convolved over the width and tallness of the info volume, registering the dab item between the sections of the channel and the information and creating a 2-dimensional actuation guide of that channel. Accordingly, the system learns channels that initiate.

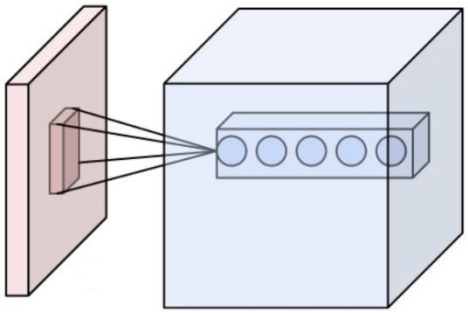

Figure 4: Neurons of a convolutional layer (blue), connected to their receptive field (red)

Stacking the enactment maps for all filters along the depth dimension measurement frames the full yield volume of the convolution layer. Every entry in the output volume can thus also be interpreted as an output of a neuron that looks at a small region in the input and shares parameters with neurons in the same activation map. Each passage in the yield volume would thus be able to likewise be translated as a yield of a neuron that takes a gander at a little locale in the information and offers parameters with neurons in a similar enactment outline.

3. *LOCAL CONNECTIVITY*

When managing high-dimensional information sources, for example, pictures, it is unrealistic to associate neurons to all neurons in the past volume in light of the fact that such system engineering does not consider the spatial structure of the information. Convolutional systems misuse spatially neighborhood relationship by implementing a nearby availability design between neurons of contiguous layers; every neuron is associated with just a little district of the info volume. The degree of this network is a hyper parameter called the open field of the neuron. The associations are neighborhood in space (along width and height), stretch out along the whole profundity of the information volume. Such engineering guarantees, to the point that the learnt channels

create the most grounded reaction to a spatially nearby information design.

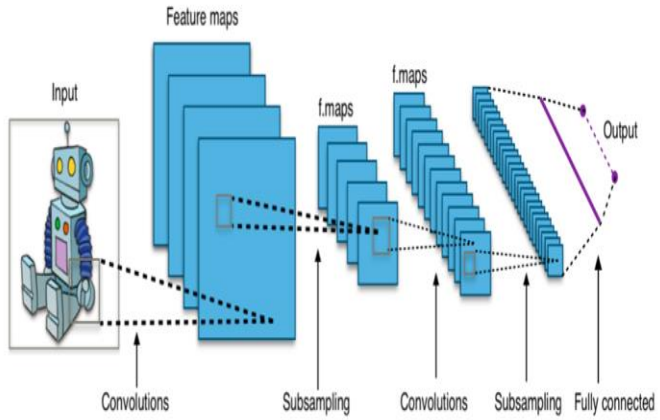

Figure 5: Typical CNN architecture

4. POOLING LAYER

Another essential idea of CNNs is pooling, which is a type of non-direct down-testing. There are a few non-straight capacities to execute pooling among which max pooling is the most well-known. It segments the information picture into an arrangement of non-covering rectangles and, for each such sub-locale, yields the most extreme. The intuition is that the exact location of a feature is less important than its rough location relative to other features. The pooling layer serves to logically reduce the spatial size of the representation, to decrease the quantity of parameters and measure of calculation in the system, and consequently to likewise control over fitting. It is essential to intermittently embed a pooling layer between dynamic convolutional layers in a CNN outline. The pooling operation gives another sort of invariance. The pooling layer works freely on each profundity cut of the info and resizes it spatially.

5. RELU LAYER

ReLU is the condensing of Rectified Linear Units. This layer applies the non-saturating activation function

$$\boldsymbol{f(x) = \max(0, x),} \quad (1)$$

It increases the nonlinear properties of the decision function and of the overall network without affecting the receptive fields of the convolution layer. Other functions are also used to increase nonlinearity, for example the saturating hyperbolic tangent

$$\boldsymbol{f(x) = \tanh(x),} \quad (2)$$

$$\boldsymbol{f(x) = |\tanh(x)|,} \quad (3)$$

And the sigmoid function

$$\boldsymbol{f(x) = (1 + e^{-x})^{-1},} \quad (4)$$

ReLU is desirable over different capacities, because it trains the neural network a few times speedier [37] without a critical punishment to speculation precision. Fully connected layer

6. FULLY CONNECTED LAYER

At last, after a few Convolutional and max pooling layers, the abnormal state thinking in the neural network is done via fully connected layers. Neurons in a completely associated layer have associations with all actuations in the past layer, as found in normal neural networks. Their initiations can consequently recompute with a matrix multiplication followed by a bias offset.

7. LOSS LAYER

The loss layer determines how training penalizes the deviation between the anticipated and true labels and typically the last layer. Different loss functions appropriate for different tasks may be used there. Softmax loss is used for predicting a single class of K fundamentally exclusive classes. Sigmoid cross-entropy loss is utilized for predicting K independent probability values in. Euclidean loss is used for regressing to real-valued labels.

LSTM Model

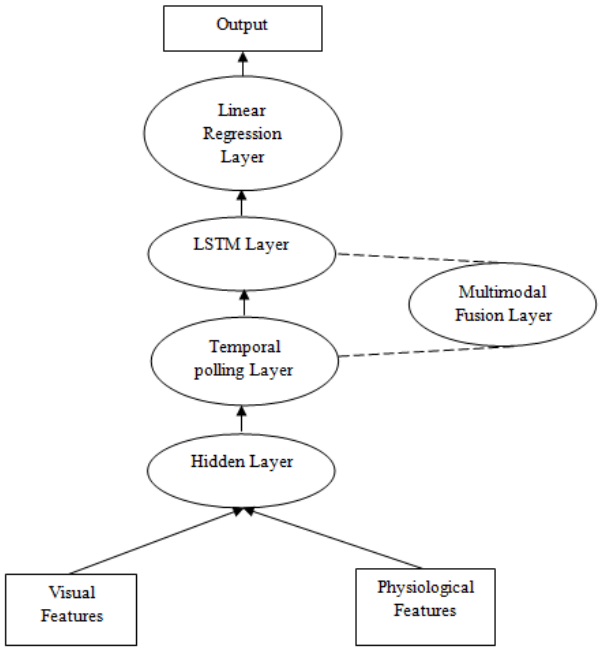

Figure 6: Long-Short Term Memory Recurrent Neural Network

The CNN show above is just fit for taking care of a single image changing it from input pixels into an interior grid or vector portrayal. We have to repeat this operation over different pictures and permit the LSTM to develop inner state and refresh weights utilizing BPTT over an arrangement of the inward vector portrayals of information images. The CNN could be settled on account of utilizing a current pre-prepared model like VGG for highlight extraction from pictures. The CNN may not be prepared, and we may wish to prepare it by back proliferating mistake from the LSTM over various info pictures to the CNN display.

In both of these cases, reasonably there is a solitary CNN display and an arrangement of LSTM models, one for each

time step. We need to apply the CNN model to each information picture and pass on the yield of each information picture to the LSTM as a solitary time step. We can accomplish this by wrapping the whole CNN input show (one layer or more) in a Time Distributed layer. This layer accomplishes the coveted result of applying a similar layer or layers numerous circumstances. For this situation, applying it numerous circumstances to various information time steps and thusly giving a grouping of "picture translations" or "picture highlights" to the LSTM model to work on [35].

In a paper Automatic Diagnosis Coding of Radiology Reports: A Comparison of Deep Learning and Conventional Classification Methods the creator Sarvnaz Karimi, Xiang Dai1, Hamed Hassanzadeh, and Anthony Nguyen said Our analyses demonstrated that some of CNN hyper parameters, for example, profundity are particular to a dataset or errand and ought to be tuned, though a portion of the parameters (e.g., learning rate or vector size) can be set ahead of time without yielding the results [34].

I. PROPOSED SYSTEM

From related work on analysis and detection of Cervical Spondylosis we decided the project flow as shown in below algorithm.

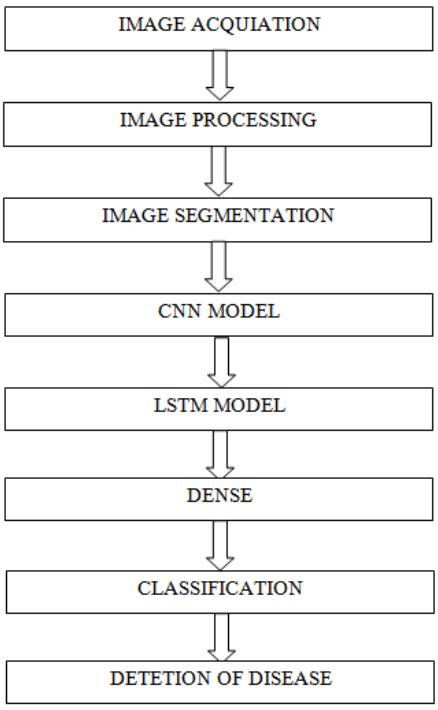

Figure 7: General block diagram Cervical Spondylosis detection system.

1. IMAGE ACQUISITION

The first stage of any vision system is the image acquisition. Converting images into digital image with the help of scanning process is called image acquisition. Image acquisition involves the steps to obtain the Cervical images with high quality images. Images are acquired from the internet field. The efficiency of the concept depends upon the quality of database images. This image is in RGB (Red, Green, and Blue) form, we will collect MRI datasets from various online repositories and also some real-time MRI scan database of live patients.

2. IMAGE PROCESSING

The digital image obtained from scanning may contain some amount of noise depending upon the quality of scanner. Deduction of this noise from captured image is called pre-processing. Image pre-processing involves the steps of image enhancement; RGB to GREY conversion, filtering, image enhancement is carried out for increasing the contrast. Image smoothing is done using the filtering techniques. There are different types of filtering techniques available in image processing like median filter, average filter, Gaussian filter etc.

3. IMAGE SEGMENTATION

Image segmentation means partitioning of image into various parts of same features or having some similarity. The segmentation can be done utilizing different strategies like Otsu method, k-means clustering, converting RGB image into HIS model etc. The K-means clustering is utilized for classification of object based on a set of features into K number of classes. The classification of object is done by minimizing the sum of the squares of the separation between the object and the corresponding cluster.

4. FEATURE EXTRACTION

Features are information extracted from the input image. This information must be similar for similar images but it must be distinct for other images. These features play major role in pattern recognition. Thus the selection of feature extraction technique becomes an important factor in achieving high recognition performance. After performing the image segmentation the disease portion from the image is extracted. Colour, texture, shape, edges, morphology are the features which can be used. We will use CNN-LSTM algorithm to perform the feature extraction as explained in above sections.

5. CLASSIFICATION

Finally, classifiers are used for the training and testing of the datasets. As the Cervical spine has a changing appearance along its length, we train a separate classifier for each region.

6. DETETION OF DISEASE

By using the above procedure we will analyse and detect the Cervical Spondylosis disease and also detect the stages

of the Cervical Spondylosis disease i.e. it is in primary stage, secondary stage and critical stage.

Based on proposed system we can expect that the CS can be detected in early staged in automatic mode with higher accuracy. Also we had summarised our literature survey, observations and findings on various method in next section.

CONCLUSION

In this paper, we have discussed various methods for the identification and classification of Cervical Spondylosisdiseases. We have also discussed the basic concept of Cervical Spondylosisdisease detection and various Cervical Spondylosis diseases symptoms and based on literature work its seems that CNN-LSTM will play very important role to detect the Cervical Spondylosis also it observed that "No automatic diagnosis available at all." But from above review paper we can conclude that some papers are showing partial automated diagnosis system, some author tried to increase efficiency of images by modifying the segmentation techniques.

Along with this we also meet to different doctors for real time survey and we got very interesting observations as follows

- In diagnosis of any vertebrae diagnosis now a day's doctors are using MRI images or CT scans.
- After getting required MRI image/ CT scans doctors are doing manual inspection for the analysis of Cervical Spondylosis detection. Those are helpful for pain diagnosis but generally not definitive and must be considered together with physical examinations and history/past experience. But this analysis is depends on lot of factors such as expertness of physician or doctor, his experience etc.
- There are so much lacunas in identification Mostly in small scale detection, Improper illumination in MRI & Image
- Capturing efficiency is depending on Operator.
- Though theoretical standard distance values are available for Cervical vertebrae, discs and distance between each other Physician does not follows these things practically, while doing prediction of Cervical Spondylosis i.e. dislocation, degeneration of Cervical Vertebrae.
- In Cervical Vertebrae all dimensions are varying from person to person with respect to gender, peoples from different countries.
- CNN-LSTM combine can become very robust detection technique for early detection of CS.

REFERENCES

[1] S. D. Boden et al, "Abnormal magnetic-resonance scans of the Cervical spine in asymptomatic subjects. A prospective investigation," The Journal of Bone & Joint Surgery, vol. 72, no. 8, pp. 1178–1184, 1990.

[2] I. J. Lehto et al,"Age-related MRI changes at 0.1 T in Cervical discs in asymptomatic subjects," Neuroradiology, vol. 36, no. 1, pp. 49–53, Jan. 1994.

[3] M. Matsumoto et al, "MRI of Cervical intervertebral discs in asymptomatic subjects," The Journal of Bone and Joint Surgery, vol. 80, no. 1, pp. 19–24, Jan. 1998.

[4] D. R. GORE et al, "Roentgenographic Findings of the Cervical Spine in Asymptomatic People," Spine, vol. 11, no. 6, pp. 521–524, Jul. 1986.

[5] J. A. Tracy ,J. D. Bartleson, "Cervical Spondylotic Myelopathy," The Neurologist, vol. 16, no. 3, pp. 176–187, May 2010.

[6] Hashemi H et al,"MRI findings of the Cervical spine lesions among symptomatic patients and Their Risk factors Neurology," 2002.

[7] Bland JH "the Cervical spine: from anatomy to clinical care," Medical Times, pp15-33, 1989.

[8] S. D. Boden et al, "Abnormal magnetic-resonance scans of the Cervical spine in asymptomatic subjects A prospective investigation," Journal of Bone and Joint Surgery, vol. 72, no. 8, pp. 1178–1184, 1990.

[9] M. Matsumoto et al, "MRI of Cervical intervertebral discs in asymptomatic subjects," Journal of Bone and Joint Surgery, vol. 80, no. 1, pp. 19–24, 1998.

[10] Xinghu Yu, Liangbi Xiang," Classifying Cervical Spondylosis Based on Fuzzy Calculation,"vol. 2014, pp 1-7, 2014.

[11] N. H. Phuong ,V. Kreinovich, "Fuzzy logic and its application sin medicine," International Journal of Medical Informatics,vol. 62, no. 2-3, pp. 165–173, 2001.

[12] K. S. Park et al, "Developing a knowledge based system to automate the diagnosis of allegricrhints,"Biomedical Fuzzy and Human Sciences, vol. 2, pp. 9–18, 1996.

[13] Y. M. Chae et al, "Aclinical decision support system for diagnosis of hearing loss," Journal of Preventive Medicine and Public Health, vol. 22, pp.57–64, 1989.

[14] S. K. Chung et al, "Decision making support system in Otolaryngology—II," Korean Journal of Otolaryngology, vol. 32, pp. 768–789, 1989.

[15] S. K. Chung et al, "Decision making support system in Otolaryngology—III," Korean Journal of Otolaryngology, vol. 33, pp. 104–110, 1990.

[16] Y.M.Chae et al, "The development of a decision support system for diagnosing nasal allergy," Yonsei Medical Journal, vol. 33, no. 1, pp. 72–80, 1992.

[17] Masaaki Hori et al,"Cervical Spondylosis: Evaluation of micro structural changes in spinal cord whitematter and gray matter by diffusional kurtosis imaging,"Magnetic Resonance Imaging vol. 32, pp. 428–432,2014.

[18] Mohammad J Alam, Khondkar S, "Possible detection of Cervical spondylotic neuropathy using Distribution of F-latency (DFL)," a new neurophysiological parameter, 23 April 2010.

[19] Mustapha Z et al, "Cervical Spine MRI Findings in Patients Presenting with Neck Pain and Radiculopathy," International Research Journals, 2014.

[20] MalteKuss, Thore Graepel, "The Geometry of Kernel Canonical Correlation Analysis", Technical Report No. 108, May 2003.

[21] S. Van Vaerenbergh et al,"Adaptive kernel canonical correlation analysis algorithms for maximum and minimum variance," INGENIO, 2010.

[22] D. R. Hardoon et al, "Canonical correlation analysis: An overview with application to learning methods," Neural Computation, vol. 16, no. 12, pp. 2638–2664, Dec. 2004.

[23] P. L. Lai, C. Fyfe, "Kernel and nonlinear canonical correlation analysis," International Journal of NeuralSystems, vol. 10, no. 5, pp. 365–377, 2000.

[24] Kenji Fukumizuet al, "Statistical Consistency of Kernel Canonical Correlation Analysis," Journal of Machine Learning Research, vol.8, pp.361-383, 2007.

[25] Christopher M. Bono et al, "Diagnosis and Treatment of Cervical Radiculopathy from Degenerative Disorders," North American Spine Society Evidence-Based Clinical Guidelines for Multidisciplinary Spine Care, 2010.

[26] M Hochman, S Tuli, "Cervical Spondylotic Myelopathy: A Review," The Internet Journal of Neurology, vol. 4, no. 1, 2004.

[27] BeyremJebri et al, "Detection of Degenerative Change in Lateral Projection Cervical Spine X-ray Images", 2015.

[28] H. Hotelling, "Relations between two sets of variates,"Biometrika, vol. 28, pp. 321–377, 1936.

[29] Tara N. Sainath et al, "Convolution, long short-term memory, fully connected deep neural networks", 2015

[30] J. R. Kettenring, "Canonical analysis of several setsof variables," Biometrika, vol.58, no. 3, pp. 433–451, 1971.

[31] F. R. Bach, M. I. Jordan, "Kernel independent component analysis," Journal of Machine Learning Research, vol. 3, pp. 1–48, 2002.

[32] J.Anish et al, "Analysis of Human Neck Image Using Pro/E and MATLAB," IJIRSET, Vol. 6, no. 2, pp. 2916-2922, 2017.

[33] Sarvnaz Karimi et al, "Automatic Diagnosis Coding of Radiology Reports: A Comparison of Deep Learning and Conventional Classification Methods," The Australian e-Health Research Centre, CSIRO, 2017.

[34] Pinkesh Badjatiya et al, "Deep Learning for Hate Speech Detection in Tweets," International World Wide Web Conference Committee, pp. 3-7, 2017.

[35] Jin Wang et al, "Dimensional Sentiment Analysis Using a Regional CNN-LSTM Model," Proceedings of the 54th Annual Meeting of the Association for Computational Linguistics, pp. 225–230,2016.

[36] Alex Krizhevsky et al, "Image Net Classification with Deep Convolutional Neural

Networks,"Advances in Neural Information Processing Systems, pp. 1097–1105**,** 2012.

[37] Oriol Vinyals et al "A neural image caption generator," CoRR, pp. 1411-4555, 2014.