Automated Electricity Bill Generation by extracting Digital Meter Reading using Back propagation neural network for OCR

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Abstract

An Artificial Neural Network (ANN)[1] is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. OCR[2] is the process of automatic extraction or determination of character image or pixel patterns in image created by human, computer or other electronic devices like camera, scanner. OCR uses an ANN (Artificial Neural Network) as the backend to solve the classification problem - a field of research in pattern recognition, artificial intelligence and machine vision. The input for the OCR is image of document (scanned text or stored image file).Here we are going to apply Back propagation algorithm to extract the meter reading from Digital Meters which will be very helpful for the operators to generate the final electricity bill as per the usage by the customer.

Index Terms: *Artificial Neural Network1,Optical Character Recognition2, , Maharashtra state electricity Board3,Back propagation*

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1. INTRODUCTION:-

Image Processing is always looked upon as a fascinating field in human computer interaction. The applications of image processing that have emerged over the last years include face recognition, image stenography, 3-D visualization and optical character recognition.

OCR (*Optical Character Recognition*) is the process of automatic extraction or determination of character image or pixel patterns in image created by human, computer or other electronic devices like camera, scanner. It is the process of reconstructing the text from an image induced by the associated noise. It is the process of translating images of handwritten, typewritten, or printed text into a format understood by machines for the purpose of editing, searching and a reduction in storage size.

OCR uses an *ANN* (Artificial Neural Network) as the backend to solve the *classification problem* - a field of research in pattern recognition, artificial intelligence and machine vision. The input for the OCR is image of document (scanned text or stored image file). An artificial neural network used here to perform character classification in OCR is a mathematical model or computational model that is inspired by the structure and functional aspects of biological neural networks.

When we visited MSEB office we found that they were facing the problem related to electricity bill generation from electricity meter photograph of customer .In this bill generation process there is a sub-process called "punching" has some problems .The operator's most of the time and efforts are needed for this process .In this application we will try to reduce the efforts and time required for the bill generation .For this reason we are going to use MATALAB Language for the "Image processing".

In MATALAB we extract the particular meters image and applying the pattern recognition on the meter reading area and put the appropriate meter reading into our application which will generate the Final Bill.

Fig 1:-Digital Meter Pattern Extraction

2. REQUIREMENT ANALYSIS:-

2.1 Optical Character Recognition

Optical character recognition refers to the process of translating images of hand-written, typewritten, or printed text into a format understood by machines for the purpose of editing, indexing or searching and a reduction in storage size. Optical character recognition is the mechanical or electronic translation of images of handwritten, typewritten or printed text into machine-editable text. Here we are using artificial neural networks to perform character recognition due to their high noise tolerance. The ANN is trained using the Back Propagation algorithm.

2.2 Feature extraction

In pattern recognition and in image processing, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant Transforming the input data into the set of features is called feature extraction. It can be used in the area of image processing which involves using algorithms to detect and isolate various desired portions or shapes (features) of a digitized image or video stream. It is particularly important in the area of OCR.

2.3 Back propagation Artificial Neural Network

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. A Back Propagation network learns by example. We give the algorithm examples of what we want the network to do and it changes the network's weights so that, when training is finished, it will give the required output for a particular input. Back Propagation networks are ideal for simple Pattern Recognition and Mapping Tasks As just mentioned, to train the network we need to give it examples of what we want the output (called the Target) for a particular input.

It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons.
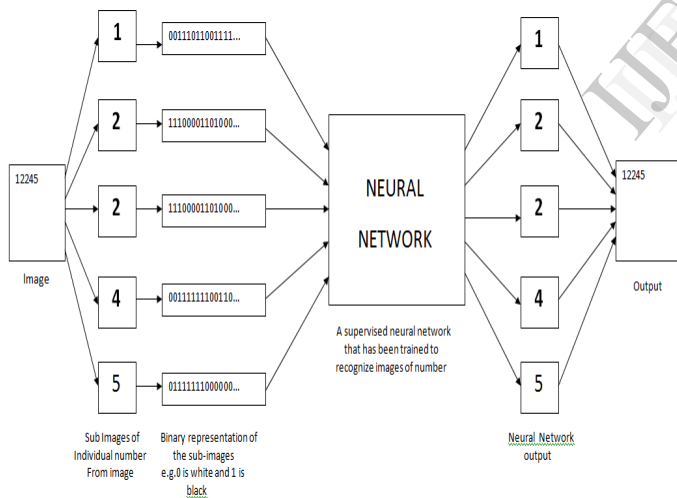
Fig 2: Back propagation neural network for OCR

3.SYTEM STUDY:-
3.1 Existing System
In present situation MSEB calculating electricity bill by collecting photographs of customer's meter by visiting the customers home and then Manually entering meter reading in database server by seeing photograph of customer's meter which will be helpful for bill generation. In this bill generation process there is a sub-process called "punching" has some problems the operator's most of the time and efforts are needed for this process.

3.2 Proposed System

To develop an application which will load the image from stored file one by one and then after apply OCR steps like image acquisition, image pre-processing, sub image analysis, feature extraction and training and recognition.
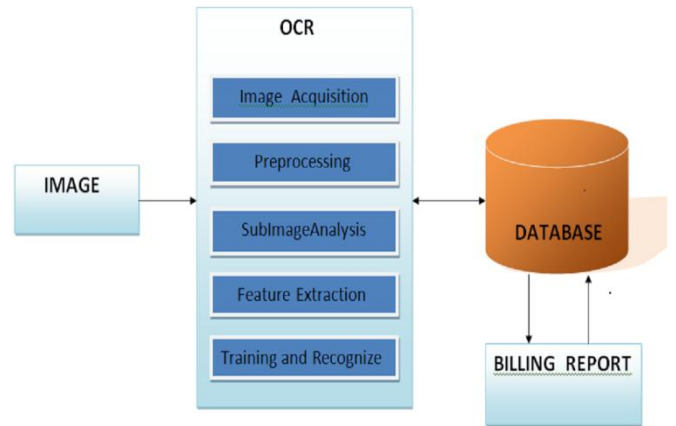
3.3 System Architecture

Fig 3: System Architecture

The above system architecture shows the overall detailed description and working of our project.
1. Image: The devices such as camera, mobiles, scanner etc are used to capture the image.
2. The input image is given to OCR. It computes the global threshold (level) of the image that can be used to convert an intensity image to a binary image. This image is compared with the samples stored automatically in to the database.
3. Database: It contains various types of samples scanned having number 0 -9. These are later used to compare with the input image.

4. RELATED WORK
The various modules covered are as follows:-
4.1 Image acquisition
Here the Captured images in the form like .jpg,.bmp,.gif from camera will get extracted in MATALAB for Pattern Recognition.

4.2 Image pre-processing
Image will be converted into 2 bit bitmap image with black and white pixels only. After then cropping region of interest area from image and increase the intensity of this sub-image (i.e. Region of interest area).Here image is segmented up to single character pattern.

4.3 Sub-image Analysis
Here segmented region of image are analyzed for pattern. These patterns are used as input for the back propagation algorithm (i.e. ANN).

4.4 feature extraction
Here pattern matrices of binary data are extract feature i.e. to create neuron .Neuron are carefully formed to produce desired output for corresponding input.

4.5 Training & reorganization
In this module we will recognize the pattern with existing pattern and get finally output produced i.e. retrieve meter number and meter reading from image. After retrieving meter number, meter number matched with existing meter number .If Meter number is matches then update meter reading into database .Finally generate electricity bill and which store again into database.

5. CONCLUSION

This paper analyzes the time and efforts taken by operator right now to read Meter Reading in MSEB[3] manually and calculate the appropriate bill by as per the unit rates decided by MSEB using the concepts of Back propagation algorithm in Artificial Neural Network and Optical Character Recognition.

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