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Identifying Bone Tumor Using X Ray Images

V.Mathumitha, Bonam Narasimha Reddy, Byreddy Karthikeyan Reddy

Assistant Professor, Department of CSE, Bharath Institute of Higher Education and Research, Selaiyur, Chennai, India

B. Tech Student, Bharath Institute of Higher Education and Research, Selaiyur, Chennai, India

B. Tech Student, Bharath Institute of Higher Education and Research, Selaiyur, Chennai, India

ABSTRACT: More number of deaths occurring every year due to a common health issue, cancer. It is one of the diseases distributed over large areas. Among all, bone cancer is most predominant, having a high death rate. Hence this is most important and a lot of research is going on and to identify bone cancer X-RAY scanned images are used. They provide a picture detailed with the growth of the tumor and track its growth in the body so it is better by providing good results compared to other techniques. Therefore in medical fields most of the image processing techniques are used to detect cancer in its early stages. In this project we present an approach to detect bone cancer in scanned images. The steps involved in it are proposed using methods of image preprocessing where median filter is used followed by segmentation where mathematical morphological operations are used. Geometrical features like area, perimeter, and eccentricity are calculated to the tumor detected part. At last CNN classifier is used to classify whether it is cancerous (Malignant) or normal (Benign). In our project we will be using the following algorithms for classification like Support Vector Machine (SVM) as existing and Convolution Neural Network (CNN) as proposed and its accuracy has been calculated and well compared. From the results obtained it is proved that the proposed Convolution Neural Network (CNN) performs better than existing Support Vector Machine (SVM).

I. INTRODUCTION

Cancer is a widespread disease where deaths due to it are increasing nowadays. Among all, Bone cancer is predominant for men and male compared to all other cancers. It occurs because of uncontrollable cell growth in bone tissues. It is caused due to smoking and eating tobacco causing cancer in bone tissues. The cancerous nodules are called malignant tumors. Bone cancer is the leading cause of cancer deaths worldwide. Despite advances in detection and diagnosis and therapies, many people still develop fatal diseases. If cancer gets detected early, its fatality rate decreases. Higher the detection time higher the fatality. Bone Cancer is classified into two major groups based on the cell size i) cell size is small and ii) cell size is large. Cancer is divided into four stages and this staging has been done according to the size of tumor and node location. Computed Tomography scanned images are more effective to be used in detecting and diagnosing bone cancer compared to the normal chest X-ray. Cigarette smoking is top in the list for the factors causing bone cancer resulting in 85% and 75% cases of male and male respectively. Bone cancer causes 29% of entire cancer deaths. There is a higher chance of survival rate when the cancer is detected in its early stages. It is estimated that males are having 85% of cancer cases and males have 75% which occurs due to cigarette smoking. There were approximately 1,372,910 cancer cases in 2005 and deaths are expected to be 5,70,280 to occur in the United States due to cancer. It is also estimated that among Those 1,63,510 deaths are caused due to bone cancer which constitutes 29% of total deaths. The computed tomography scanned image is a combination of several different X-ray images which are taken from different angles so that using it we can see the internal organ part without cutting the organ i.e; inside the organ without cutting. X-Ray scans provide better information about the images than conventional X-ray imaging, especially about blood vessels and soft tissue such as internal organs and muscles. It is an automated system so there will not be any human errors. It is also preferred over all other modalities as it has less distortion and is more reliable.

II. LITERATURE REVIEW

Cancer is the root cause for a large number of deaths worldwide, out of which bone cancer is the cause of the highest mortality rates. Computer tomography scan is employed by radiologists to detect cancer in the body and track its growth. Visual interpretation of databases can lead to cancer detection at later stages, thus leading to late treatment of cancer which only boosts up the cancer death rates. Therefore, image processing tools can be used for early detection of cancer. In this paper, a bone cancer detection algorithm is proposed using mathematical morphological operations for segmentation of the bone region of interest, from which Haralick features are extracted and used for classification of

cancer by artificial neural networks.

Alamgir Hossan Recognition and prediction of bone cancer in the earliest reference point stage can be very useful to improve the survival rate of patients. But diagnosis of cancer is one of the major challenging tasks for radiologists. For detecting, predicting and diagnosing bone cancer, an intelligent computer-aided diagnosis system can be very much useful for radiologists.

We propose in this paper an automatic algorithm for early planocellular bone cancer detection in bone X ray images. Considering the fact that bone cancer is one of the most lethal cancers and that it is usually diagnosed too late, the solution is to attempt early diagnosis at general practitioners level, using cheapest diagnostic tools, chest radiography. The proposed algorithm determines and segments the suspected area in bone X ray images. It consists of two steps: comparison between extracted planocellular bone cancer structure and the analyzed bone X ray image by calculating similarity coefficients and finding the maximum similarity coefficient which will indicate the suspected cancer affected area in the bone image. The obtained results are promising and confirm that the proposed algorithm should serve as the foundation for future research in this area.

Bone cancer is the most life-threatening disease, treatment of which must be the primary goal throughout scientific research. The early recognition of cancer can be helpful in curing disease 10 entirely. There are numerous techniques found in literature for detection of bone cancer. Several investigators have contributed their facts for cancer prediction. These papers largely pact about prevailing bone cancer detection techniques that are obtainable in the literature. A number of methodologies have originated in cancer detection 19 methodologies to progress the efficiency of their detection. Diverse applications like as support vector machines, neural networks, image processing techniques are extensively used in for cancer detection which is elaborated in this work.

III. METHODOLOGY

Existing System

To detect an ideal hyperplane for different distinct examples in a high dimensional space is the main process of the SVM. To fulfill this model there is more than one hyperplane. This process depends upon the bolster vector with the information that lies nearest on the closed surface and coordinating with the ideal choice surface. It performs classification by planning the input vectors into a high dimensional space and constructing the hyperplane to separate the data. This strategy is mainly used to solve a quadratic programming problem and non-convex, unconstrained minimization problem. The SVM is the most effective method in the classifier process.

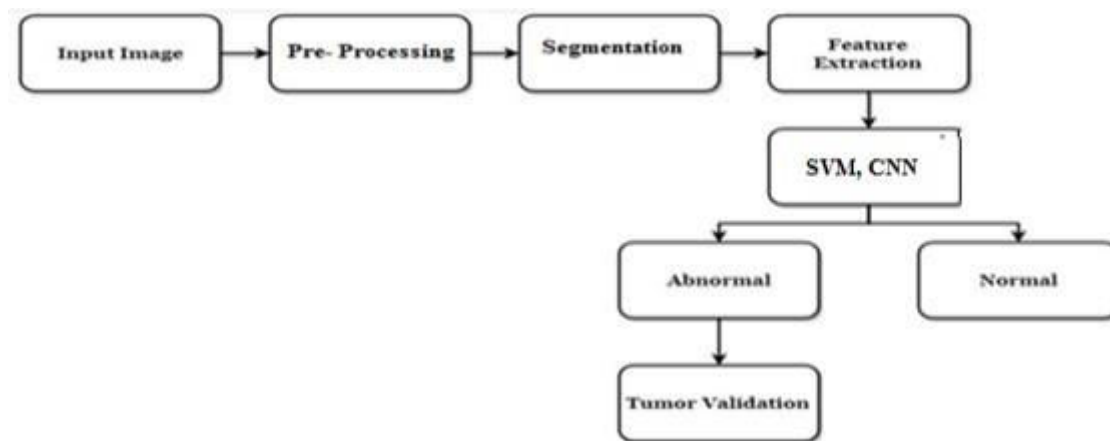
Disadvantages of Existing System: Only edges are detected. Time consumption. More complexity. Less efficiency. Noise is high.

- Only edges have been detected.
- Time consumption.

Proposed system

In deep learning, a Convolutional Neural Network (CNN or ConvNet) is a specialized class of deep neural networks, primarily designed for processing and analyzing visual data. CNNs have revolutionized the field of computer vision due to their powerful ability to automatically learn spatial hierarchies of features from input images. These networks are commonly used in a variety of applications, such as image and video recognition, image classification, image segmentation, medical image analysis, natural language processing, recommender systems, brain-computer interfaces, and financial time series forecasting. CNNs are also referred to as Shift Invariant or Space Invariant Artificial Neural Networks (SIANN). This terminology arises from their shared-weight architecture and translation invariance properties, which allow them to detect patterns regardless of their position in the input field. This ability makes them highly efficient and robust for visual tasks, as patterns such as edges, textures, or shapes can appear anywhere in the image. 14 Unlike traditional Multilayer Perceptrons (MLPs), where each neuron is fully connected to every neuron in the adjacent layers, CNNs adopt a more localized and structured approach. The fully connected nature of MLPs often leads to a large number of parameters, making the network prone to overfitting, especially when the training data is limited. While regularization techniques like L1 or L2 weight penalties are commonly used to mitigate overfitting in MLPs, CNNs inherently possess a form of regularization through their architectural design. CNNs reduce the number of

parameters significantly by using convolutional layers, which apply learned filters over small local regions of the input. This design exploits the spatial locality in data and enables the network to capture hierarchical structures. Lower layers typically learn to detect simple features like edges or corners, while higher layers combine these into more complex patterns and objects. This hierarchical pattern learning is not only efficient but also aligns with how biological systems, such as the visual cortex of animals, process visual information. In biological terms, each neuron in the visual cortex is responsive to a specific region in the visual field, known as its receptive field. CNNs mimic this structure, with each filter scanning across the image and focusing on specific receptive fields. Overlapping receptive fields ensure full coverage of the visual input while maintaining locality. Another key advantage of CNNs is their minimal reliance on manual feature engineering. In traditional computer vision systems, features such as edges, textures, and shapes needed to be manually designed using domain expertise. CNNs, in contrast, automatically learn the optimal features directly from the data, reducing human effort and bias. This data-driven approach makes CNNs are highly adaptable and scalable to a wide range of domains and tasks.



IV. SYSTEM STUDY

The feasibility of the project is analyzed in this phase and a business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential. The feasibility study investigates the problem and the information needs of the stakeholders. It seeks to determine the resources required to provide an information systems solution, the cost and benefits of such a solution, and the feasibility of such a solution. The analyst conducting the study gathers information using a variety of methods, the most popular of which are: Developing and administering questionnaires to interested stakeholders, such as potential users of the information system. Observing or monitoring users of the current system to determine their needs as well as their satisfaction and dissatisfaction with the current system. Collecting, examining, and analyzing documents, reports, layouts, procedures, manuals, and any other documentation relating to the operations of the current system. Modeling, observing, and simulating the work activities of the current system. The goal of the feasibility study is to consider alternative information systems solutions, evaluate their feasibility, and propose the alternative most suitable to the organization. The feasibility of a proposed solution is evaluated in terms of its components. These components are:

ECONOMICAL FEASIBILITY

The economic feasibility study is conducted to evaluate the financial viability and cost-effectiveness of the proposed system. It assesses whether the benefits derived from the implementation of the system justify the investment made. Given the limited budget allocated by the organization for research, development, and deployment, it is crucial to ensure that all expenditures are well-justified and aligned with financial constraints. In the case of this system, economic feasibility was successfully achieved by leveraging open-source and freely available technologies, significantly reducing licensing and software costs. The only major expenditures involved were for acquiring customized components or third-party services necessary for system integration. This strategic cost control helped maintain the overall project within budget while delivering high value and functionality.

TECHNICAL FEASIBILITY

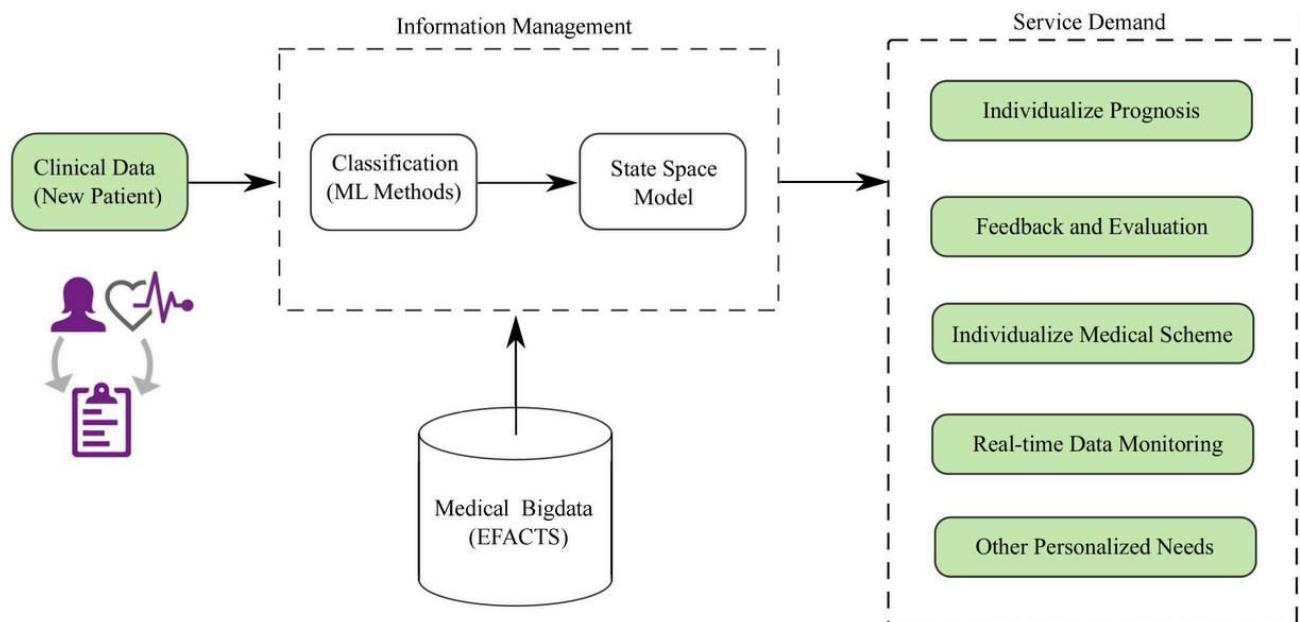
The technical feasibility study examines whether the current technical resources—both hardware and software—can support the development and implementation of the proposed system. It is essential that the new system does not impose excessive technical demands on existing infrastructure or require major overhauls of current systems, which could lead to increased costs, complexity, and downtime. In this project, all efforts were made to ensure that the system remains compatible with the organization's current technical environment. The requirements were kept modest, ensuring minimal or no additional hardware procurement or software upgrades. The design emphasizes compatibility, scalability, and ease of integration with existing systems. As a result, the system can be implemented smoothly without significantly burdening the technical team or infrastructure.

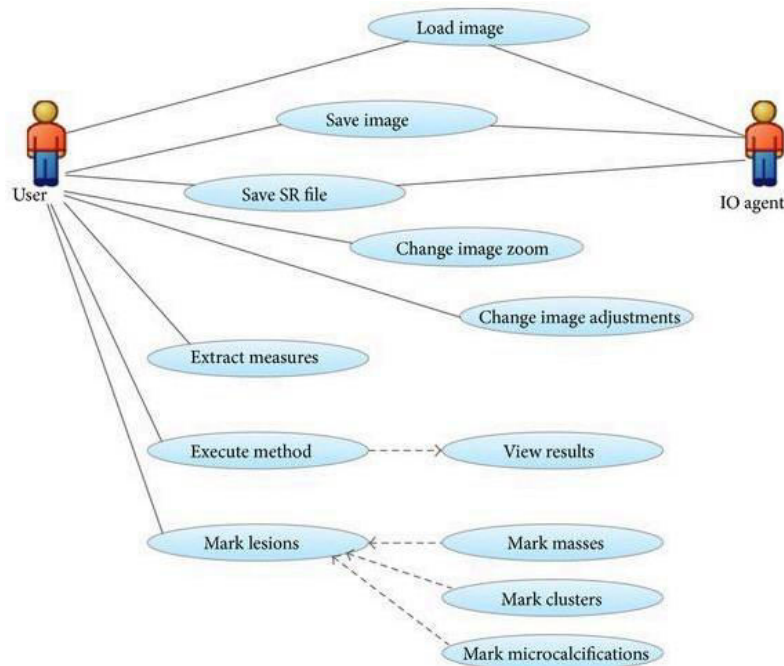
SOCIAL FEASIBILITY

Social feasibility is focused on understanding the user acceptance and adaptability towards the new system. It evaluates the attitudes, expectations, and readiness of end users to embrace the technological changes. A system, no matter how well designed, will only succeed if the people using it are comfortable and confident with it. To ensure high levels of user acceptance, comprehensive training programs and awareness sessions were conducted. The objective was to eliminate any sense of threat or uncertainty among users. The system is designed to be user-friendly and intuitive, promoting confidence and reducing the learning curve. Additionally, users are encouraged to provide feedback and suggestions for improvement.

OPERATIONAL FEASIBILITY

The ability, desire, and willingness of the stakeholders to use, support, and operate the proposed computer information system. The stakeholders include management, employees, customers, and suppliers. The stakeholders are interested in systems that are easy to operate, make few, if any, errors, produce the desired information, and fall within the objectives of the organization.





V. RESULT AND CONCLUSION

This project has effectively demonstrated the application of machine learning (ML) techniques to classify bone cancer as either benign or malignant. The research presents a comprehensive study on how bone cancer, a critical health concern, can be detected using intelligent classification methods that assist in early and accurate diagnosis. By leveraging image processing techniques and extracting relevant texture features from X-ray images, the system was able to train robust ML models capable of distinguishing between normal and cancerous bone tissues. The ML models were evaluated and compared against existing conventional methods based on performance metrics such as accuracy and precision. It was observed that the machine learning-based classification approach adopted in this project outperformed traditional algorithms. The proposed system achieved higher accuracy and demonstrated greater reliability in detecting malignancies in bone X-rays. The improved classification efficiency is attributed to the optimal selection of features and the utilization of robust learning algorithms, making this approach a viable and effective tool in medical diagnostics. In summary, the implementation of ML techniques not only provides enhanced performance in terms of classification accuracy but also contributes to reducing manual diagnostic errors. It offers a scalable and adaptable framework that can significantly aid radiologists and medical professionals in the early detection of bone cancer, ultimately improving patient outcomes.

VI. FUTURE WORK

The accurate and early detection of bone cancer is crucial in reducing the mortality rate associated with the disease. The earlier the cancer is diagnosed, the higher the chances of successful treatment. Hence, there is a significant potential for future research and development in this domain. In this project, X-ray images sourced from the mini-MIAS database were utilized for experimental analysis. This dataset comprises images, including 270 normal and 52 cancerous cases, providing a foundational basis for training and validation. From each image, ten texture features were extracted using the Gray Level Co-occurrence Matrix (GLCM) along a 0° angle. To enhance model performance and reduce computational complexity, feature selection was performed using a rank-based method, narrowing the feature set down to six highly significant features. The system yielded a validation and testing accuracy of 92%, with the overall accuracy reaching an impressive 94.4% using the proposed ML-based approach. The implications of this research are far-reaching. The developed methodology can be extended and adapted to detect other bone-related disorders and anomalies by training the model on diverse datasets. The capability of the model to handle small clusters of data and identify minor anomalies makes it particularly suitable for detecting localized tumor segments. Future enhancements can include the incorporation of deep learning techniques, such as convolutional neural networks (CNNs), which may offer further improvements in detection accuracy. Moreover, expanding the dataset to include a larger and more varied

set of X-ray images from different sources and patient demographics would make the model more robust and generalizable. Integration with clinical decision support systems (CDSS) and real-time diagnostic tools could enable automated, on-the-fly analysis of medical images in clinical settings. In conclusion, the proposed technique lays a solid foundation for developing advanced diagnostic systems in oncology. With further refinement, it holds the promise of becoming a critical component in the early and reliable detection of bone cancer and other musculoskeletal disorders

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