International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 06 June 2024, pp: 965-977 www.ijaem.net ISSN: 2395-5252

Development of an Expert System for Breast Cancer Diagnosis Using Deep Learning

Okereke, Oluchi Faith[1]. Dr. Nuka Nwaibu[2], Dr. Daniel Mattias[3]
Department of Computer Science, Rivers State University, Port Harcourt,Nigeria

---
Date of Submission: 20-06-2024 Date of Acceptance: 30-06-2024

ABSTRACT: An expert system is a computer system emulating the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning through bodies of knowledge. The most common method of knowledge representation in expert systems is the use of production rules. A production rule, or simply a rule, consists of an IF part (a condition or premise) and a THEN part (an action or conclusion). IF condition THEN action (conclusion). Rule-based expert systems demand deep knowledge of the domain as well as a lot of manual work. Generating rules for a complex system is quite challenging and time consuming. Furthermore, it is not easy to mimic the behavior of humans in rule-based expert systems. Deep learning is a method in artificial intelligence that can be used in building computers and machines that can reason, learn, and act in such a way that would normally require human intelligence or that involves data whose scale exceeds what humans can analyze. Deep learning is part of a broader family of machine learning methods based on artificial neural networks with representation learning. The adoption of deep learning is the current trend in building expert systems but however, it has not been utilized in breast cancer expert systems development. The work presents a model of breast cancer expert system using deep learning. The model was trained with a published dataset of breast cancer diagnosis. The predictions of the model are in good agreement with actual values at 98% accuracy.

Keywords: Breast Cancer,Deep Learning,Diagnosis

I. INTRODUCTION

Expert System (ES) is a branch and the strongest of the branches of Artificial Intelligence (AI), which turned out to be the most important branch of computer science. The purpose is to detect certain problems in a particular field, by extracting, compiling, analyzing, and re-using information and experience of the human expert in the field and annexed into the system. (Winanto, 2016) These systems can address the problems in this area without fully relying on a specialist to diagnose their problems by confining the symptom and criteria information collected. (Naser, 2016).

Artificial intelligence technology plays a major role in diagnosis and decision-making in the medical field (Miottoet al., 2018). Many applications were developed using machine learning and deep learning to assist with a number of tasks, such as the classification, detection and segmentation of cancer. Currently, deep learning is the most popular method (Biswa, 2022).

Cancer is the uncontrolled growth of abnormal cells anywhere in the body. These abnormal cells are termed cancer cells, malignant cells, or tumor cells. These cells can infiltrate normal body

Tissues. Many cancers and the abnormal cells that compose the cancer tissue are further identified By the name of the tissue that the abnormal cells originated from (for example, cancer, lung cancer, and colorectal cancer). When damaged or unrepaired cells do not die and become cancer cells and show uncontrolled division and growth a mass of cancer cells develop.

routinely, disease cells can obliterate a long way from this special mass of cells, venture through the blood Furthermore, lymph frameworks, and hotel in various organs in which they can again rehash the uncontrolled blast cycle. This system of most diseases cells leaving a spot and filling in some other body place is called metastatic spread or metastasis. the clever part of this look at relates to the outline of the greatest late examination on the product of profound acquiring information on to disease identification and furthermore the utility of expert machine for analysis of most malignant growths, but this reviews is designated on the use of each the expert gadget and profound dominating procedure for determination and choice making for the machine.

II. LITERATURE REVIEW

2.1 View of Related Works on Medical Expert Systems and Cancer Expert Systems

This chapter dissects the possible areas where expert systems have helped in the medical field and also a view on different cancer diagnosis expert systems

2.2 Application of Expert System in the Medical Field

Abu Naser et al. (2016) fostered a specialist framework for decrease lower back ache conclusion and remedy: This paper proposes a expert framework that may be utilized to research low again torment focus emphatically. This framework requests the facet outcomes then in end it may pick the sickness growing these side consequences and advocate the right therapy.

The information primarily based framework can examine seven neck ailments of various periods of the human existence beginning through posing the patron several inquiries as indicated by means of their agony facet effects. SL5 object language, a general based language became applied in planning and executing the facts-based Framework for neck illnesses conclusion.

III. SYSTEM DESIGN

The System architecture refers to the placement of the software components on physical machines. define the core components (functional components) or steps required as pre-processing, feature extraction, detection and classification of cancer cells. Figure 1 show the system architecture on the system.

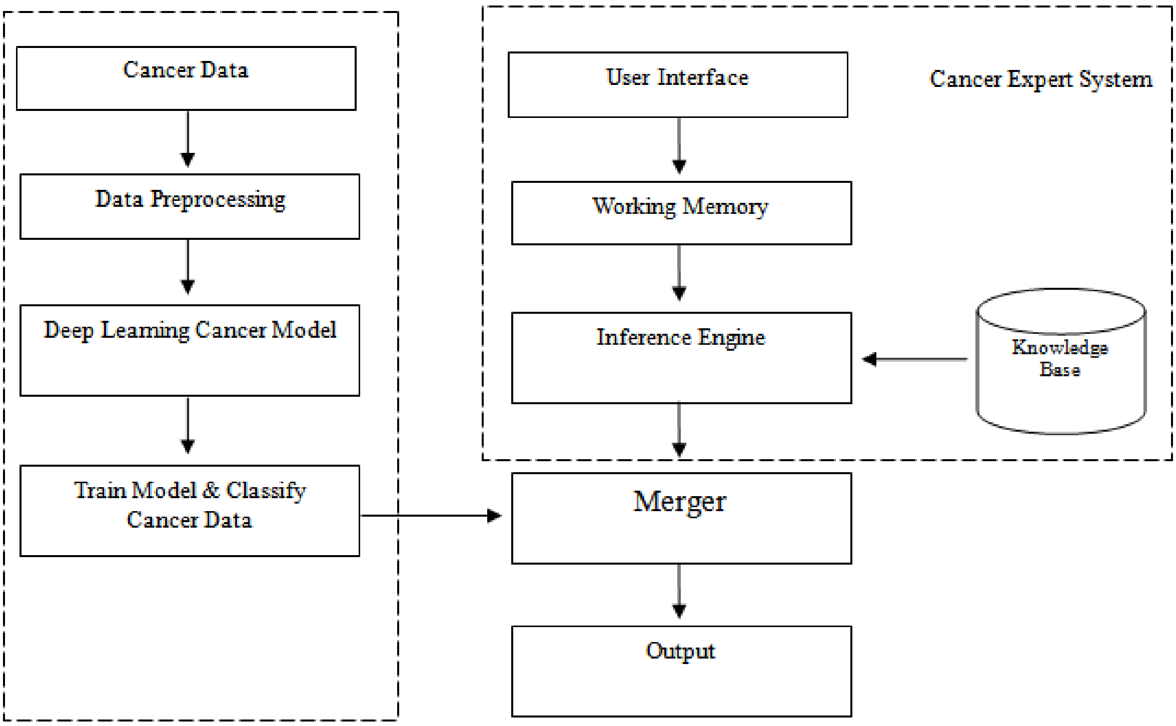

Figure 1: System Architecture

Components of the Proposed System
The components of the proposed system architecture are discussed below:

i. Dataset
Dataset sourcedataset sample dataset info columns: 33 rows: 569 **more info and number of null values**

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean
0	842302	M	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001
1	842517	M	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869
2	84300903	M	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974
3	84348301	M	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414
4	84358402	M	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 569 entries, 0 to 568
Data columns (total 33 columns):
 #   Column                   Non-Null Count  Dtype
---  ------                   --------------  -----
 0   id                       569 non-null    int64
 1   diagnosis                569 non-null    object
 2   radius_mean              569 non-null    float64
 3   texture_mean             569 non-null    float64
 4   perimeter_mean           569 non-null    float64
 5   area_mean                569 non-null    float64
 6   smoothness_mean          569 non-null    float64
 7   compactness_mean         569 non-null    float64
 8   concavity_mean           569 non-null    float64
 9   concave points_mean      569 non-null    float64
 10  symmetry_mean            569 non-null    float64
 11  fractal_dimension_mean   569 non-null    float64
 12  radius_se                569 non-null    float64
 13  texture_se               569 non-null    float64
 14  perimeter_se             569 non-null    float64
 15  area_se                  569 non-null    float64
 16  smoothness_se            569 non-null    float64
 17  compactness_se           569 non-null    float64
 18  concavity_se             569 non-null    float64
 19  concave points_se        569 non-null    float64
...
 31  fractal_dimension_worst  569 non-null    float64
 32  Unnamed: 32              0 non-null      float64
```

dataset features:
'id', 'diagnosis', 'radius_mean', 'texture_mean', 'perimeter_mean', 'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean', 'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean', 'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se', 'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se', 'fractal_dimension_se', 'radius_worst', 'texture_worst', 'perimeter_worst', 'area_worst', 'smoothness_worst', 'compactness_worst', 'concavity_worst', 'concave points_worst', 'symmetry_worst', 'fractal_dimension_worst', 'Unnamed: 32'

dataset target features unique values are:
B = Begin
M = Malignant **target**

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 06 June 2024, pp: 965-977 www.ijaem.net ISSN: 2395-5252

The UML Diagram

The use case diagram as a unified modeling language (UML) tool used at the analysis phase of system development to describe the relationship between the various actors in the software system and what they are expected to do for the proposed model at the analysis phase.

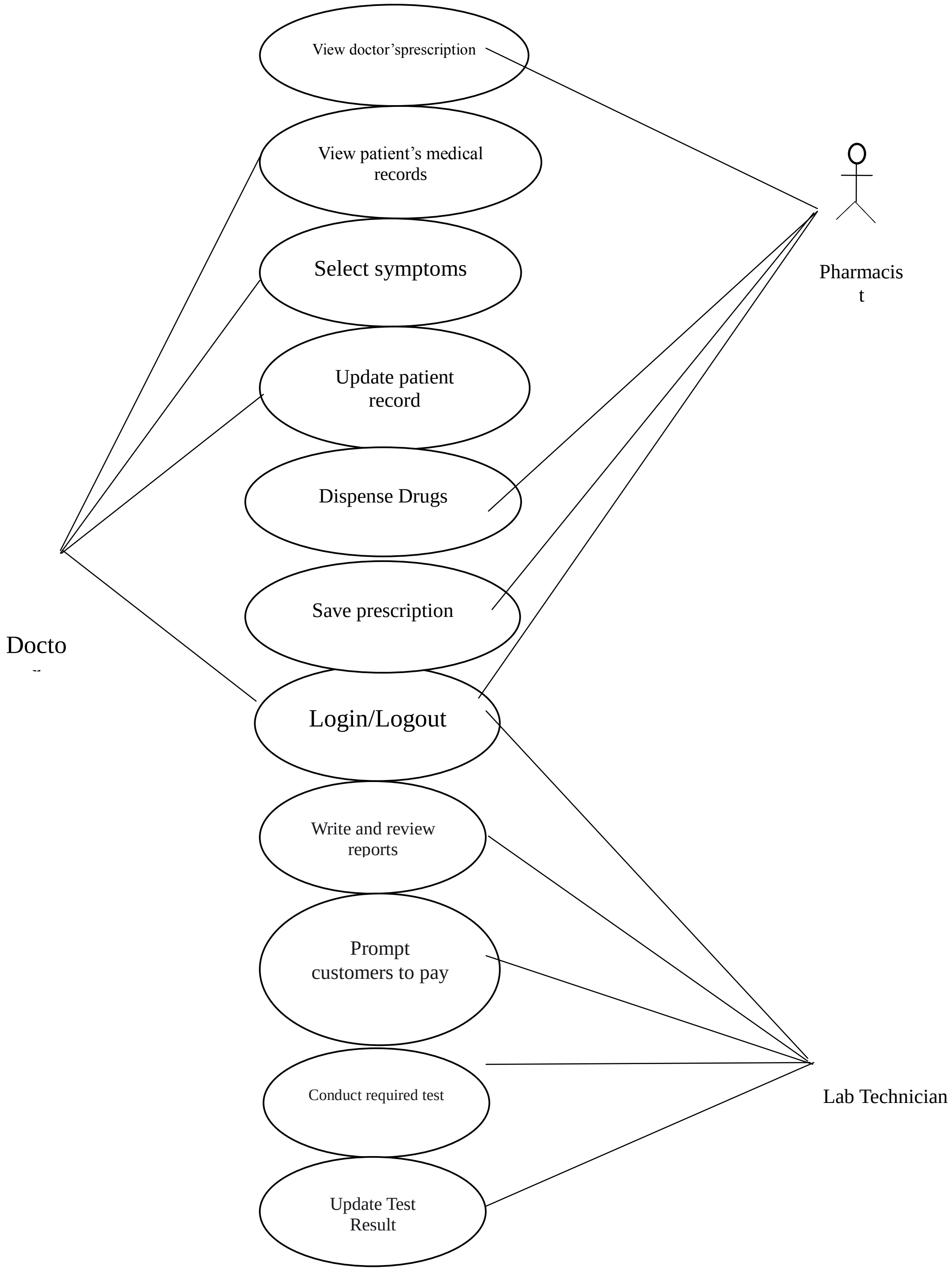

Figure 3.3: Use-Case diagram of the Proposed System

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 06 June 2024, pp: 965-977 www.ijaem.net ISSN: 2395-5252

The above figure 3.1 indicates the usage case graph as an UML device utilized inside the exam length of the model to seize the realistic a part of the proposed framework necessities. The entertainers are displayed as stick figures at the same time as the utilization case is displayed as a strong boundary oval and bolts (conventional lines) applied to expose the connection between the special entertainers (Framework and purchaser) to perform the proposed framework goal. The utilization case outline of proposed framework displaying the framework works and the way it pals with the different framework parts.

Table 3.2 Use-case Description

Actor	**Use case**	**Description**
Doctor	Login/Logout	The doctor gets access to the system by logging in and leaves the system by logging out
	View patient's medical records	The doctor can view patient's medical records
	select symptoms	The doctor selects the possible symptoms the patient is exhibiting
	Update patients record	The doctor updates the patient's medical record
Lab Technician	Login/Logout	The Lab technician gets access to the system by logging in and leaves the system by logging out
	View and review report	The Lab technician is responsible for reviewing and writing reports
	Prompt customer for payment	The lab technician also prompts the customers to make payments
	Conduct the required test	Finally, the lab technician conducts medical test on patients
	Update test results	After conducting The Lab Technician would update the test result
Pharmacist	Login/Logout	The pharmacist gets access to the system by logging in and leaves the system by logging out
	View doctor's prescription	The pharmacist views what the doctor has prescribed
	Save prescription	The pharmacist saves what the doctor has prescribed for patients
	Prompt for payment	The Pharmacist also prompts the patient to make payments based on the drugs dispensed
	Dispense drugs	Finally, the drug is given to the patient after payment is done

3.5 System Design

Systems design is the process of defining elements of a system like modules, architecture, components and their interfaces and data for a system based on the specified requirements.

3.5.2 Activity Diagram

This diagram represents movement of activities from one operation to another. Figure 3.5 shows the operations performed by the user on the Deep learning intelligent system.

3.5.3 Class Diagram: A class diagram in the Unified Modeling Language is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations, and the relationships among objects.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 06 June 2024, pp: 965-977 www.ijaem.net ISSN: 2395-5252

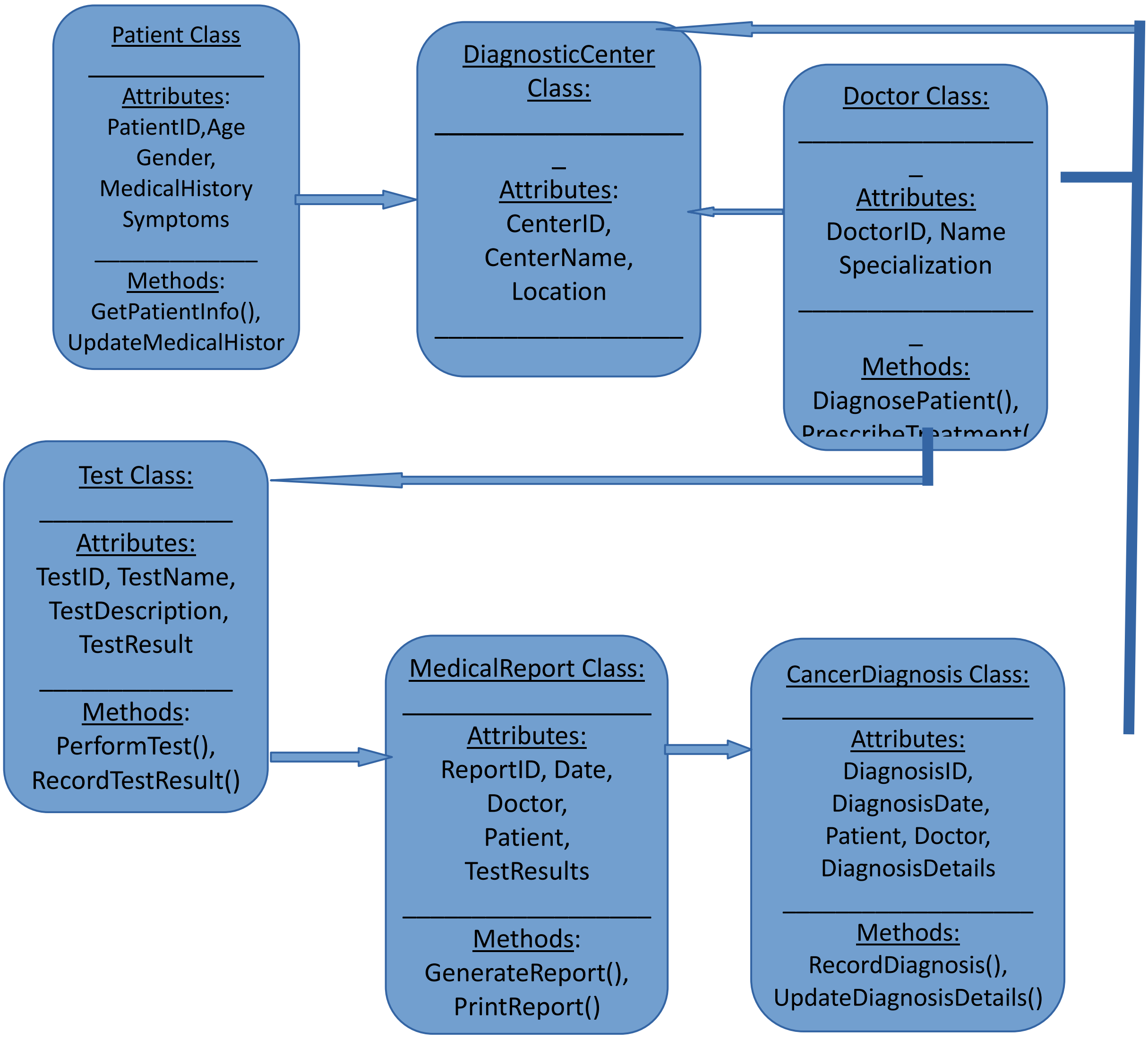

Figure 3.6: Class Diagram

Inference Engine

The kind of inference engine adopted was the forward chaining which applies a set of rules and facts to deduce conclusions, searching the rules until it finds one where the IF clause is known to be true. The process of matching new or existing facts against rules is called pattern matching,

When a condition is found to be TRUE, the engine executes the THEN clause, which results in new information being added to its dataset. In other words, the engine starts with a number of facts and applies rules to derive all possible conclusions from those facts.

The fact that the inference engine starts with the data and reasons its way forward to the answer, as opposed to backward chaining, which works the other way around.

RULES

RULE 1

IF X {chest pain AND wheezing AND weight loss = True}
THEN A {Lung Cancer}

RULE 2

IF X {lump in the breast AND bloody discharge from the nipple AND changes in the shape OR (texture of the nipple or breast) =True}
THEN A {Breast Cancer }

RULE 3:

IF X {Pain during urination Urinary AND (difficulty starting and maintaining a steady stream of urine) = True}
THEN A {Bladder Cancer }

IV. RESULTS AND DISCUSSION

4.1 Results

The figures and tables below are information obtained from implementing the proposed system

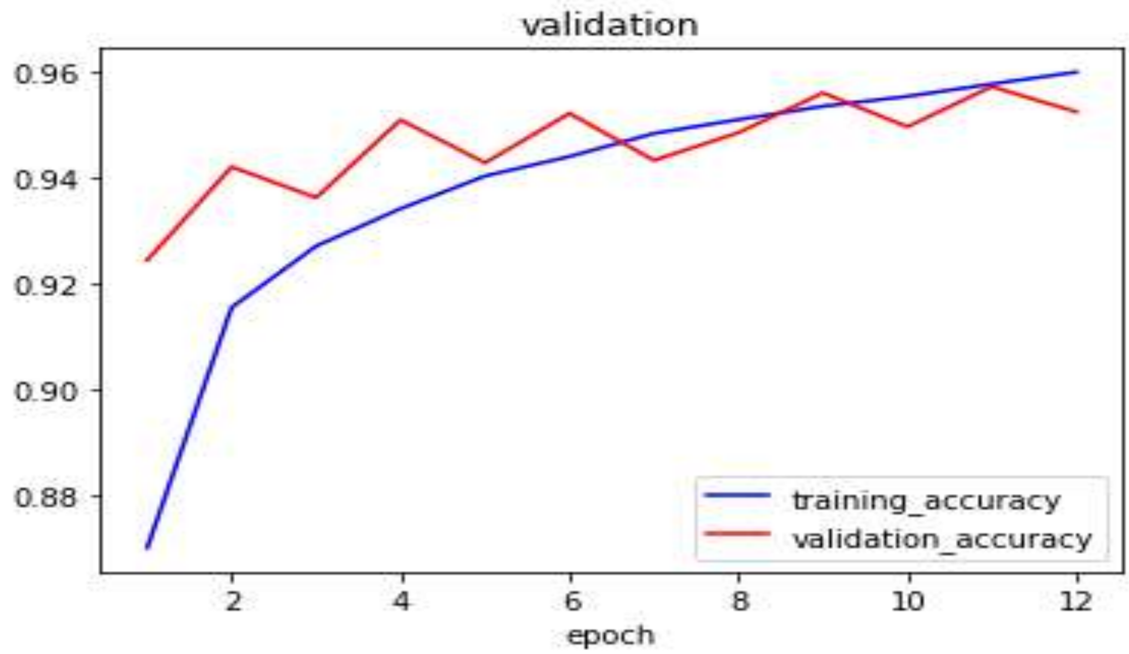

Figure 4.1: Training Accuracy

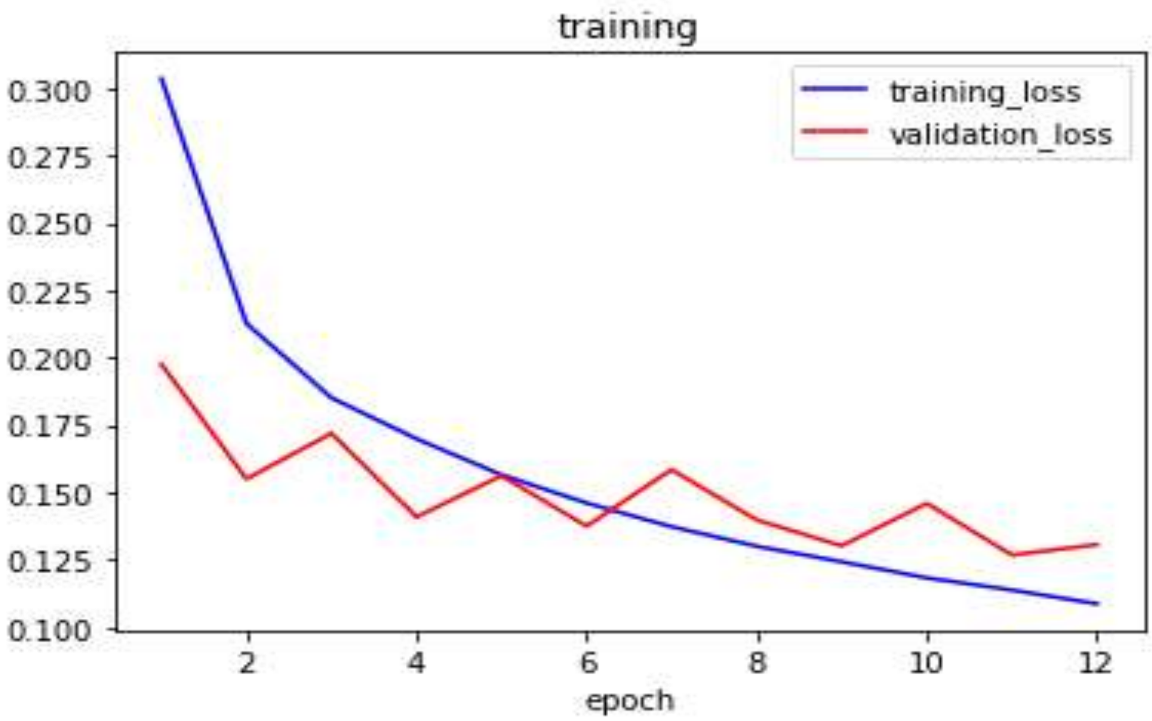

Figure 4.2: Training Loss Validation

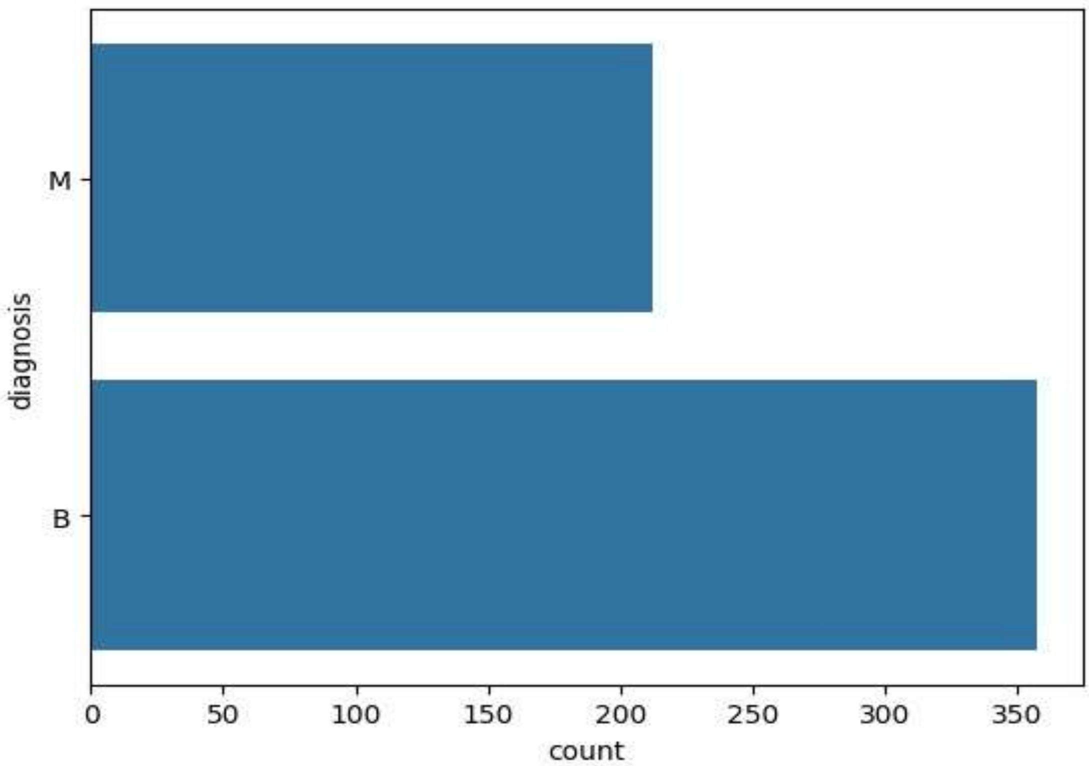

Figure 4.3: Features Distributions: Dataset target features unique values are B = Begin and M = Malignant

Table 4.1: Predicted and Actual Results

S/N	Predicted	Actual
1	M	M
2	B	B
3	B	B
4	B	B
5	M	M
6	B	B
7	B	B
8	B	B
9	M	M
10	B	M
11	M	M
12	B	B
13	M	M
14	B	M
15	B	B
16	B	B
17	B	B
18	M	M
19	B	B
20	B	B
21	M	B
22	B	B
23	B	B
24	B	B
25	M	M
26	B	B
27	M	M
28	B	B
29	M	B
30	M	M

International Journal of Advances in Engineering and Management (IJAEM)
Volume 6, Issue 06 June 2024, pp: 965-977 www.ijaem.net ISSN: 2395-5252

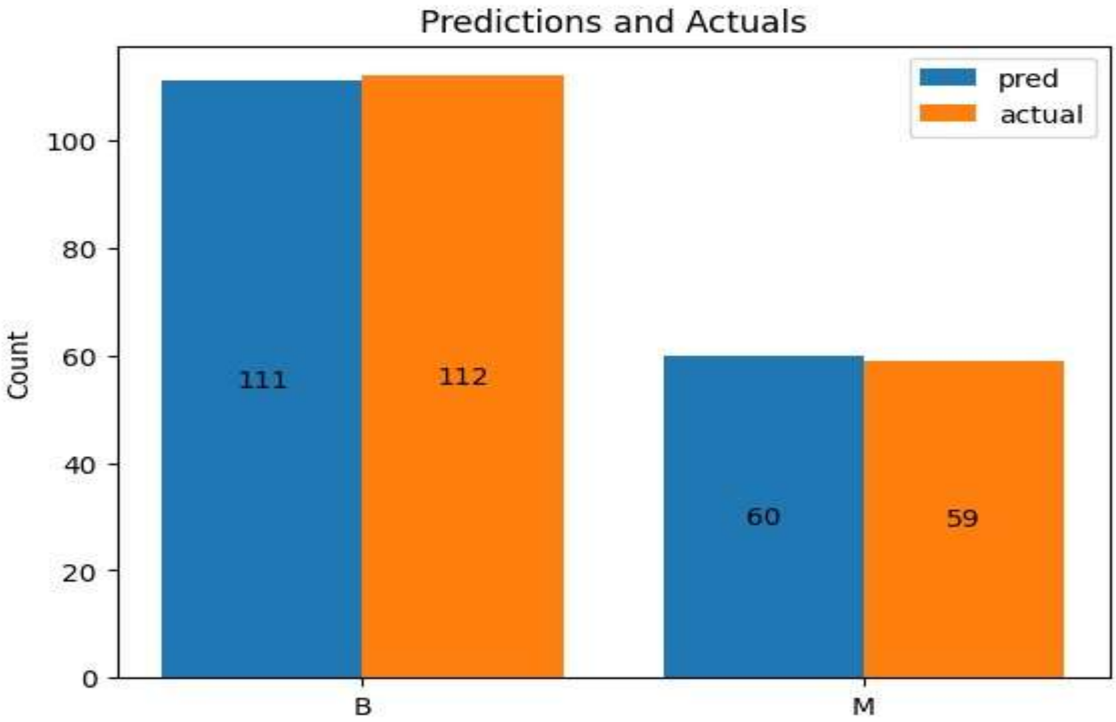

Figure 4.4: Actual and Predicted Results from the Dataset

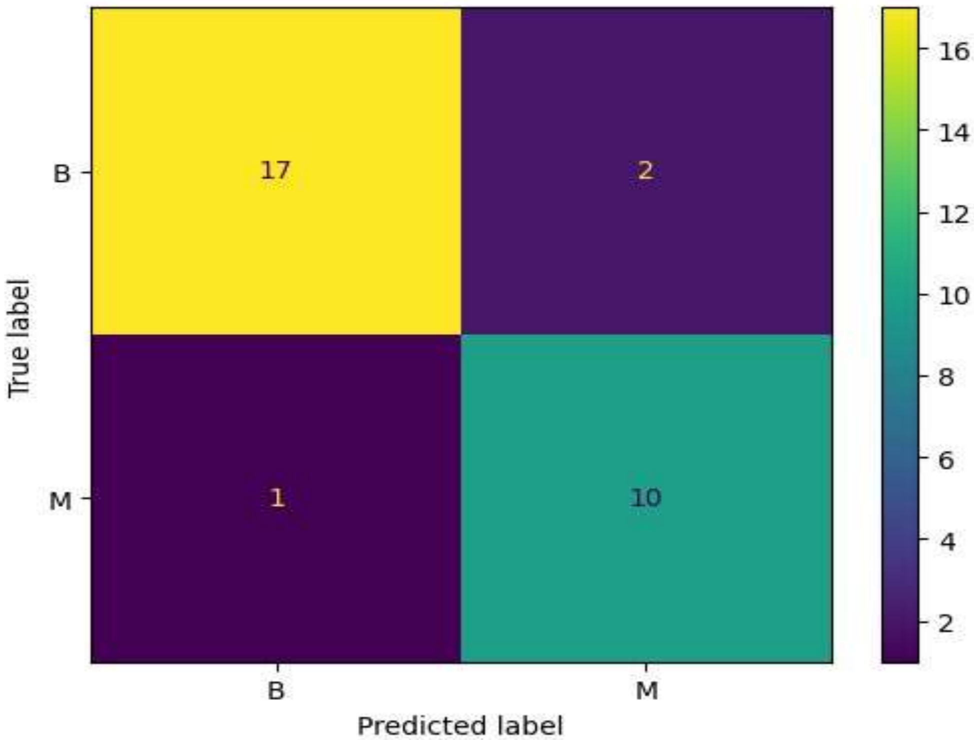

Figure 4.5: Confusion Matrix of the Evaluation of the Model

Figure 4.6: Symptom Selection Interface

Figure 4.7: interface showing other Cancer Types

Figure 4.8: Selecting Breast Cancer Symptoms

V. DISCUSSION

The testing of all the expert system modules generated more than 50 test cases. Since the implementation of these systematic methods for testing the proposed expert system were implemented, the rate of implementation and logic errors decreased significantly. The evaluation of the prototype was conducted using historical patient records that have final diagnosis. 112 breast cancer cases were considered. All the cases selected for the evaluation had been diagnosed in a hospital. After entering the patient details the system was invoked to give a diagnosis. The diagnosis given by the expert system was compared to the diagnosis in the dataset recorded. Using the expert system, the list of diagnoses suggested by the system contained the correct diagnosis in 111 of the 112 cases (98.9%). The 1 diagnosis that was not suggested was not included in the expert system database at the time of the evaluation.

VI. CONCLUSION

Breast cancer if found at an early stage will help save lives of thousands of women. These projects help patients and doctors to gather as much information as they can. With the system, one will be able to classify and predict the cancer into begin or malignant. Expert systems developed using machine learning algorithm can reduce human errors and lowers manual mistakes. It is also important that the cost of diagnosis will be as low as possible. This application can act as an interface between the less privileged for the diagnosis of diseases.

REFERENCES

[1]. Abad-Grau, J. (2021). worked on the computerized decision support for critical and emergency care.

[2]. Abdullah, S. (2011) developed an expert system using fuzzy for diagnosis of hypertension

[3]. Abu, N. (2016). Developed an expert system for Lower Back Pain Diagnosis and Treatment:

[4]. Al-Bayed, M., (2016). Worked onDetecting Health Problems Related to Addiction of Video Game Playing Using an Expert System

[5]. Al-Hanjori, D. (2016). Worked on an expert system for men genital problems diagnosis and treatment

[6]. Arvind, K. (2021). Developed a Machine learning expert systems for disease diagnostics in human healthcare

[7]. Munaiseche1, C. P. C. (2017). Developed An Expert System for Diagnosing Eye Diseases using Forward Chaining Method.

[8]. El-Najjar (2016). Worked on expert system for nausea and vomiting problems in infants and children

[9]. Fatih, B., Emre, A. (2016). Developed an expert system to diagnose cancer by using a new method reduced rule base.

[10]. Fatih, B.& Omer, F. H. (2016). Worked on the Reduced-rule based expert system by the simplification of logic functions for the diagnosis of diabetes.

[11]. Gudu, (2012). Developed a Medical Expert System as an Expert Knowledge Sharing Tool on Diagnosis and Treatment of Hypertension in Pregnancy

[12]. Karabatak&Ince (2009). Worked on an automatic diagnosis system for detecting breast cancer
[13]. Karthick (2022). Developed a cardiovascular disease prediction
[14]. Keles (2011). Developed the fuzzy rules which will be used in inference engine
[15]. Khellaet al., (2017) developed an Expert System for Chest Pain in Infants and Children
[16]. Klar, R & Zaiss, (A 2007). Developed a medical expert system for design and applications in pulmonary medicine
[17]. Lucas, P. J. & Janssens, A. R. (2009). Development and validation of HEPAR
[18]. Marchevsky, A. M. & Coons, I. G. (2003). Developed an expert systems as an aid for the pathologist's role of clinical consultant: CANCER-STAGE
[19]. Marchevsky, A M 1 (2001). Developed Expert systems for efficient handling of medical information in Lung cancer.
[20]. Mohamed, A. (2022). Developed a deep learning that can prototypically and successfullycategorize histopathological images
[21]. Bartels,P. H. & Hiessl, H. (2006). Developed an expert system in histopathology
[22]. Harber, P. (2002). Worked on the structure of expert diagnostic knowledge in occupational medicine.
[23]. Salim et al., (2016). Worked on expert system for helping the Podiatric physician in diagnosing patients
[24]. Shaath et al., (2016). Developed an Expert system urination problems diagnosis.