International Journal of Electrical and Computer Engineering (IJECE)
Vol. 8, No. 4, August 2018, pp. 2442~2450
ISSN: 2088-8708, DOI: 10.11591/ijece.v8i4.pp2442-2450

The Utilization of Physics Parameter to Classify Histopathology Types of Invasive Ductal Carcinoma (IDC) and Invasive Lobular Carcinoma (ILC) by using K-Nearest Neighbourhood (KNN) Method

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Article Info

Article history:

Received Jan 31, 2018
Revised Apr 2, 2018
Accepted Apr 20, 2018

Keyword:

Invasive ductal carcinoma
Invasive lobular carcinoma
Nearest neighbourhood

ABSTRACT

Medical imaging process has evolved since 1996 until now. The forming of Computer Aided Diagnostic (CAD) is very helpful to the radiologists to diagnose breast cancer. KNN method is a method to do classification toward the object based on the learning data which the range is nearest to the object. We analysed two types of cancers IDC dan ILC. 10 parameters were observed in 1-10 pixels distance in 145 IDC dan 7 ILC. We found that the Mean of Hm(yd,d) at 1-5 pixeis the only significant parameters that distingguish IDC and ILC. This parameter at 1-5 pixels should be applied in KNN method. This finding need to be tested in diffrerent areas before it will be applied in cancer diagnostic.

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1. INTRODUCTION

The diagnosing of early breast cancer is very important to reduce the mortality rate for women. The breast cancer is the health problem in the world, many women die because of it. Most of the patients who come to have treatment have had advanced stage. Therefore, the early detection of breast cancer and its treatment is the only way to survive longer and to improve the patients’ life quality. CAD system that is evolved is very helpful in diagnosing breast cancer. Besides, CAD system can also be used as the comparison of diagnostic result of the radiologists and the pathology and anatomy specialist doctors. In this kind of CAD system, the accuracy of result is very important. A misguided detection can cause a misguided treatment too. Because the problem is sensitive, there are many researchers do the research in breast cancer specialty and compete each other to achieve the better result.

The technologies developed all this time to detect early breast cancer are Ultrasonography (USG) device [1], [2], Mammography, Magnetic Resonance Imaging (MRI) [4], [5], and Positron Emission Tomography (PET) Scan [6]. All early detection tools above are unable to classify IDC and ILC histopathology types. Therefore, we propose a new technique to classify IDC and ILC histopathology types by using physics parameter as the input variable by using KNN method. Software that we produced would be planted in Mammography tool so that it could improve its activity as an early detection of breast cancer.

The research that we proposed was focused on mammogram images from Dokter Soetomo (Surabaya, Indonesia) Hospital, Sanglah (Denpasar, Bali, Indonesia) Hospital, and from Prima Medika

(Denpasar, Bali, Indonesia) Hospital producing classification of IDC and ILC histopathology types. IDC was currently categorized into invasive carcinoma of no special type was terrace breast carcinoma, namely it was from 45% to 75% case, whereas ILC was only from 5 to 15% invasive breast carcinoma [7]. The disparity between these two types was clinicopathology characteristic and response regarding systemic therapy [8]. IDC Histopathology gave the growth image of invasive epithelium malignant cells which mostly form solid and sinsisial patterns, and part with glandular and tubules differentiation. ILC consists of epithelium malignant cells arranged in the spreading of individual cell or arranged in infiltrative linear pattern between fibrus connective tissue stroma and it was usually connected with lobular carcinoma in situ (LCIS) [7].

In our paper, we proposed a new method to classify histopathology types of ILC and IDC breast cancers. Because of the physics parameter value range of ILC and IDC was different [9]. So, physics parameter containing on the mammogram could be used as the input variable for KNN method to determine whether it belonged to ILC or IDC types.

The superiority of the method that we proposed was the output of our method was numerical form which its value was certainly to be very objective, it was different with the previous method that still used the visual reading which the result was very subjective and depending on the readers. Why did we do the research? We wanted to help decreasing the mortality rate of women who have had breast cancer.

The aim of the writing is to introduce a new method to detect the types of IDC and ILC histopathology. CAD system that we have developed is used as the comparison of FNAB result before doing the operation.

2. METHODS

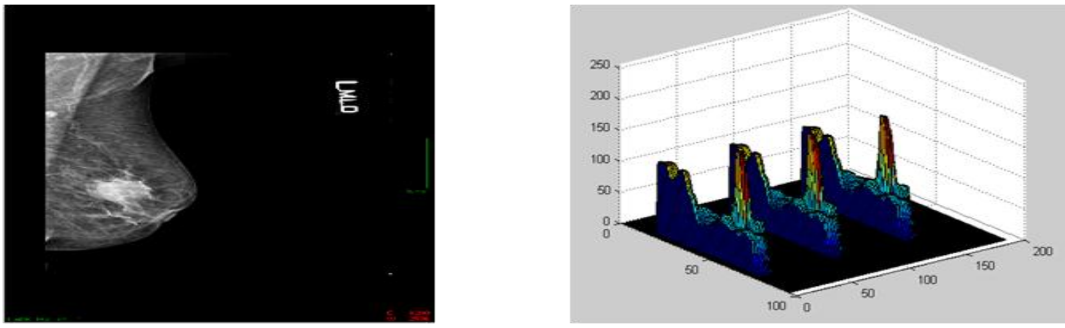
2.1. Sample

The research was approved by ethics committee of Sanglah Hospital, Denpasar, Bali, Indonesia. Number: 1204/UN.14.2/KEP/2017. The samples were taken at random from the year 2013 to the year 2017 from the database of Dokter Soetomo Hospital (Surabaya, Indonesia), Prima Medika Hospital (Denpasar, Bali, Indonesia), Sanglah General and Central Hospital (Denpasar, Bali, Indonesia). The samples consisted of 7 images of ILC type and 145 images of IDC type.

2.2. Developed method

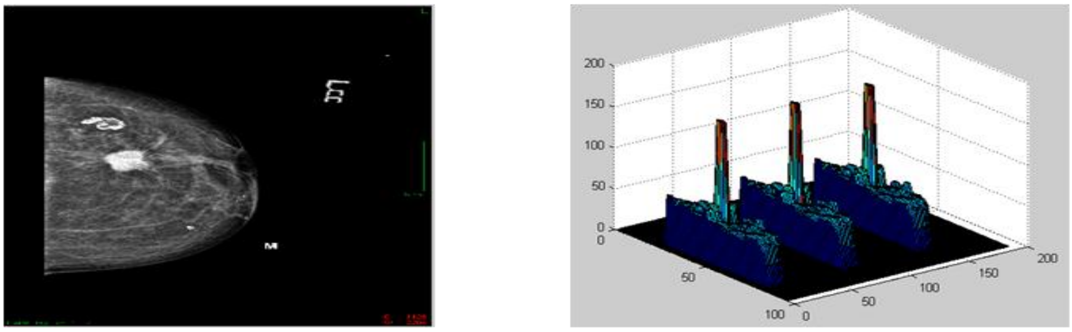
Gunawan [9] used physics parameter to determine histopathology types of breast cancer by using Special Pattern Cropping method. In this research, we developed the use of physics parameter as the input of KNN method to determine histopathology type of breast cancer.

It has been observed that the abnormality, especially the suspicious are with the higher density than the neighbor pixel like on the Figure 1 and Figure 2. We counted 9 physics parameters like entropy, contrast, angular second moment, inverse difference moment, mean of Hm(y,d), deviation, entropy of H_{diff}, angular second moment of Hdiff and mean of H_{diff} for every pixel with the range between pixels from 1 pixel to 10 pixels. By using Anova statistics to get significant parameter that was able to distinguish IDC and ILC histopathology types. Then, we used chosen physics parameter as input variable from KNN method to take the final decision. We applied the pre-processing steps at the early algorithm to fix the image quality. The aim of repairing application of image quality was to clarify the image on mammogram. The block diagram explaining the method used was showed on Figure 3.



(a) (b)

Figure 1. (a) IDC, (b) Subtract the background image of the original image
Image: From the data base of Radiology Department of RSUP. Dr. Soetomo Surabaya Hospital.



(a) (b)

Figure 2. (a) ILC, (b) Subtract the background image of the original image
Image: From the data base of Radiology Department of RSUP. Dr. Soetomo Surabaya Hospital.

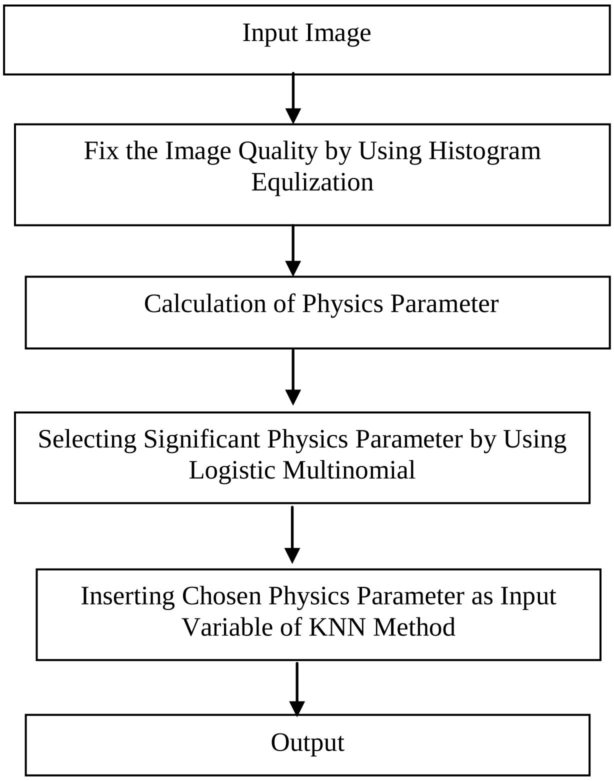


Figure 3. The steps of proposed algorithm

2.3. Processing

The aim of Processing step is to group mammogram images of ILC and IDC taken from the anatomic Pathologic research as the standard goal. Cropping the suspicious area. Then, it is done the reparation of the image quality to clarify the mammogram image.

2.4. The calculation of physics parameter

After the processing step, our algorithm counts 9 physics parameters, namely entropy, contrast, angular second moment, inverse differential moment, mean, deviation, entropy of Hdiff, angular second moment of Hdiff and mean of Hdiff at the range from 1 pixel to 10 pixels by using the Equations (1)-(13). The counted entropy from the histogram of order two provides the measurement of irregularity and defined like Equation (1). Histogram of order 2 illustrates the distribution of possibilities from the event of the pair of gray-level.

$$Entropy\ (E) = -\sum_{y_q=y_1}^{y_t}\sum_{y_r=y_1}^{y_t}\left[H(y_q,y_r,d)\right]\log[H(y_q,y_r,d)] \quad (1)$$

$$Contrast\ (C) = \sum_{y_q=y_1}^{y_t}\sum_{y_r=y_1}^{y_t}(y_q-y_r)^2\, H(y_t,y_r,d) \quad (2)$$

$$\text{Angular Second Moment (MA)} = \sum_{y_q=y_1}^{y_t}\sum_{y_r=y_1}^{y_t}[H(y_q,y_r,d)]^2 \quad (3)$$

$$Momen\ Differensial\ Invers\ (MD) = \sum_{y_q=y_1}^{y_t}\sum_{y_r=y_1}^{y_t}\left[\frac{H(y_q,y_r,d)}{1+(y_q-y_r)^2}\right] \quad (4)$$

for $y_r \neq y_q$

$$Correlation\ (Corr) = \frac{\sum_{y_q=y_1}^{y_t}\sum_{y_r=y_1}^{y_t} y_q y_r H(y_q,y_r,d) - \mu H_m(y_q,d)\mu H_m(y_r,d)}{\sigma H_m(y_{qq},d)\sigma H_m(y_r,d)} \quad (5)$$

with

$$H_m(y_q,d) = \sum_{y_r=y_1}^{y_t} H(y_q,y_r,d) \quad (6)$$

$$H_m(y_r,d) = \sum_{y_q=y_1}^{y_t} H(y_q,y_r,d) \quad (7)$$

$$Mean\ (MN) = \sum_{y_q=y_1}^{y_t} y_q H_m(y_q,d) \quad (8)$$

$$Deviation\ (D) = \sqrt{\sum_{y_q=y_1}^{y_t}[y_q - \sum_{y_p=y_1}^{y_t} y_p H_m(y_p,d)]^2 H_m(y_q,d)} \quad (9)$$

$$H_{diff}(i,d) = \sum_{y_q=|y_q-y_r|=i}^{y_t}\sum_{y_r=y_1}^{y_t} H(y_q,y_r,d) \quad (10)$$

$$Entropy\ of\ H_{diff}\ (EH) = -\sum_{i=i_1}^{i_t} H_{diff}(i,d)\log H_{diff}(i,d) \quad (11)$$

$$AngularMoment\ \ of\ H_{diff}\ (MAH) = \sum_{i=i_1}^{i_t}[H_{diff}(i,d)]^2 \quad (12)$$

$$Mean\ of\ H_{diff}\ (MHD) = \sum_{i=i_1}^{i_t} i\, H_{diff}(i,d) \quad (13)$$

With $H(y_q,y_r,d)$, d, y each is the probability of a pair of gray-level, the distance between the pixel and gray level value, respectively [10], [11].

2.5. The selection of physics variable

Selection of significant physics variables as input KNN method that is able to distinguish type IDC and ILC using T test statistical analysis. The main reason why we used KNN method to determine invasive lobular carcinoma and invasive ductal carcinoma in breast cancer, because the categorization based on the nearest range between examined data with learning data used the Euclidean Distance formula like the Equation (14).

2.6. KNN method

KNN method is a method to do classification toward the object based on the learning data which the range is nearest to the object.

To calculate Euclidean Distance by using the Equation (14).

$$D = \sqrt{\sum_{i=1}^{i=n}\left(T_i - U_i\right)^2} \quad (14)$$

It consists of 2 input variables, namely mean1 and mean2 and 2 histopathology types, namely ILC and IDC. If there is a new data with mean1 value 180.81088 and mean2 = 181.11186, is like Table 1.

Table 1. Mean1 and Mean2 and 2 Histopathology Types

Mean1	Mean2	Type of Histopathology
114.26825	113.97313	IDC
91.31764	91.71834	IDC
150.37279	151.51907	IDC
142.07158	142.72827	IDC
155.47071	156.30185	IDC
159.96244	161.16492	ILC
149.01149	148.98700	ILC
153.83340	153.93231	ILC
149.59902	149.84301	ILC
161.06060	161.83271	ILC

The Steps:

1. Determine k parameter= the nearest neighbor number. For instance k =3.
2. Calculate the range between a new data and a learning data, is like Table 2.

Table 2. Range Between a New Data and a Learning Data

Mean1	Mean2	The range quadrate with the new data (180.81088, 181.11186)
114.26825	113.97313	$(114.26825- 180.81088)^2 + (113.97313- 181.11186)^2 =$ 8935.530673
91.31764	91.71834	$(91.31764- 180.81088)^2 + (91.71834- 181.11186)^2 =$ 16000.24142
150.37279	151.51907	$(150.37279- 180.81088)^2 + (151.51907- 181.11186)^2 =$ 1802.210543
142.07158	142.72827	$(142.07158- 180.81088)^2 + (142.72827- 181.11186)^2 =$ 2974.033346
155.47071	156.30185	$(155.47071- 180.81088)^2 + (156.30185- 181.11186)^2 =$ 1257.660812
159.96244	161.16492	$(159.96244- 180.81088)^2 + (161.16492- 181.11186)^2 =$ 832.5378658
149.01149	148.98700	$(149.01149- 180.81088)^2 + (148.98700- 181.11186)^2 =$ 2043.207834
153.83340	153.93231	$(153.83340- 180.81088)^2 + (153.93231- 181.11186)^2 =$ 1466.512365
149.59902	149.84301	$(149.59902- 180.81088)^2 + (149.84301- 181.11186)^2 =$ 1951.921185
161.06060	161.83271	$(161.06060- 180.81088)^2 + (161.83271- 181.11186)^2 =$ 761.7591848

3. The range order and the determination of the nearest neighbor based on the k minimum, is like Table 3.

Table 3. Determination of the Nearest Neighbor Based on the k Minimum

Mean1	Mean2	The range quadrate with the new data (180.81088, 181.11186)	Minimum range level	Including the nearest neighbor
114.26825	113.97313	$(114.26825- 180.81088)^2 + (113.97313- 181.11186)^2$ = 8935.530673	9	IDC
91.31764	91.71834	$(91.31764- 180.81088)^2 + (91.71834- 181.11186)^2$ = 16000.24142	10	IDC
150.37279	151.51907	$(150.37279- 180.81088)^2 + (151.51907- 181.11186)^2$ = 1802.210543	5	IDC
142.07158	142.72827	$(142.07158- 180.81088)^2 + (142.72827- 181.11186)^2$ = 2974.033346	8	IDC
155.47071	156.30185	$(155.47071- 180.81088)^2 + (156.30185- 181.11186)^2$ = 1257.660812	3	IDC
159.96244	161.16492	$(159.96244- 180.81088)^2 + (161.16492- 181.11186)^2$ = 832.5378658	2	ILC
149.01149	148.98700	$(149.01149- 180.81088)^2 + (148.98700- 181.11186)^2$ = 2043.207834	7	ILC
153.83340	153.93231	$(153.83340- 180.81088)^2 + (153.93231- 181.11186)^2$ = 1466.512365	4	ILC
149.59902	149.84301	$(149.59902- 180.81088)^2 + (149.84301- 181.11186)^2$ = 1951.921185	6	ILC
161.06060	161.83271	$(161.06060- 180.81088)^2 + (161.83271- 181.11186)^2$ = 761.7591848	1	ILC

From the three levels, ILC histopathology type comes out two times, whereas IDC comes out one, it means mean1 value = 180.81088 and mean2 = 181.11186 including ILC group.

3. RESULTS AND DISCUSSION

Table 4 shows the average of physics parameter of idc and ilc at various distance (pixels) at Dr Sutomo Hospital Surabaya at 2017.

Table 4. Average of Physics Parameter of IDC and ILC at various distance (pixels) at Dr Sutomo Hospital Surabaya at 2017

	Pixel	IDC (n=148)			ILC (n=7)			Signifikansi
		Average	Standart deviation	Standart error	Average	Standart deviation	Standart error	
Entropy	1	3.6104536	0.15085807	0.01252808	3.6171657	0.08066793	0.03048961	0.907
	2	3.6568468	0.15332612	0.01273304	3.6617500	0.07960890	0.03008933	0.933
	3	3.6777772	0.15452700	0.01283277	3.6813429	0.07883346	0.02979625	0.952
	4	3.6885450	0.15457833	0.01283703	3.6888114	0.07873740	0.02975994	0.996
	5	3.6947606	0.15360226	0.01275597	3.6952657	0.07904419	0.02987590	0.993
	6	3.6949498	0.15554954	0.01291769	3.6998771	0.07793913	0.02945822	0.934
	7	3.6982033	0.15187368	0.01261242	3.7000300	0.07765963	0.02935258	0.975
	8	3.6965695	0.15078884	.01252233	3.6977043	00.07783147	0.02941753	0.984
	9	3.6941683	0.14933956	0.01240198	3.6966014	0.07457322	0.02818603	0.966
	10	3.6909294	0.14800686	0.01229130	3.6916357	0.07334534	0.02772193	0.990
Contras	1	315.1388486	177.70143713	14.75730112	339.7269071	251.49710240	95.05696977	0.726
	2	499.2650374	300.94027582	24.99172961	552.7721929	479.90755321	181.38800544	0.656
	3	656.7864110	395.39781826	32.83600155	569.0755014	489.84205140	185.14289281	0.937
	4	801.8035399	484.31155031	40.21988509	779.0552014	512.88993163	193.85417272	0.904
	5	937.9186496	571.04196611	47.42245409	885.5693447	553.34877610	209.14617855	0.813
	6	1063.7877057	653.23207514	54.24797114	988.7686614	599.97791773	226.77033749	0.766
	7	1181.3326292	732.63307678	60.84186542	1085.7139914	649.32149292	245.42045588	0.735
	8	1291.0414610	809.84046662	67.25359016	1177.5454200	701.23899871	265.04342860	0.716
	9	1396.3682258	889.44363204	73.86427323	1264.6367414	758.53064057	286.69763383	0.701
	10	1494.5215899	966.88745656	80.29563279	1347.9700171	813.56216396	307.49759456	0.694
Anguler second moment	1	0.0003488	0.00015695	0.00001303	0.0003714	0.00017102	0.00006464	0.711
	2	0.0002964	0.000012514	0.00001039	0.0002857	0.00005593	0.00002114	0.823
	3	0.0002806	0.00012200	0.00001013	0.0002714	0.00005146	0.00001945	0.843
	4	0.0002726	0.00012036	0.00001000	0.0002643	0.00005062	0.00001913	0.857
	5	0.0002673	0.00011942	0.00000992	0.0002614	0.00005146	0.00001945	0.897
	6	0.0002639	0.00011959	0.00000993	0.0002571	0.00004786	0.00001809	0.883
	7	0.0002623	0.00011742	0.00000975	0.0002571	0.00004786	0.00001809	0.909
	8	0.0002616	0.00011728	0.00000974	0.0002571	0.00004786	0.00001809	0.921
	9	0.0002619	0.00011727	0.00000974	0.0002571	0.00004192	0.00001584	0.916
	10	0.0002629	0.00011695	0.00000971	0.0002571	0.00004192	0.00001584	0.897
Invers differensial moment	1	0.0547979	0.01312559	0.00109002	0.0520400	0.00878544	0.00332058	0.584
	2	0.0473543	0.03097366	0.00257222	0.0437914	0.00605996	0.00229045	0.762
	3	0.0401514	0.01083754	0.00090001	0.0385729	0.00577497	0.00218273	0.703
	4	0.0384927	0.02187408	0.00181654	0.0361086	0.00613606	0.00231921	0.775
	5	0.0344490	0.01014603	0.00084258	0.0340371	0.00624037	0.00235864	0.916
	6	0.0326346	0.00972193	0.00080736	0.0323700	0.00596515	0.00225461	0.943
	7	0.0310297	0.00974142	0.00080898	0.0312786	0.00615010	0.00232452	0.947
	8	0.0296746	0.00940930	0.00078140	0.0299643	0.00546359	0.00206504	0.936
	9	0.0285969	0.00945333	0.00078506	0.0285969	0.00945333	0.00078506	0.930
	10	0.0276533	0.00925452	0.00076855	0.0279657	0.00546788	0.00206666	0.930
Mean of Hm(y,d)	1	133.5669281	27.19744514	2.25862488	154.4756100	16.19232902	6.12012510	0.046
	2	133.9853676	27.26778725	2.26446648	154.9300529	16.22254719	6.13154650	0.046
	3	134.3513773	27.32300711	2.26905224	155.2295157	16.21027822	6.12690927	0.047
	4	134.6905923	27.37766341	2.27359120	155.4813714	16.17205405	6.11246189	0.049
	5	135.0195647	27.41287327	2.27651522	155.6828743	16.11552700	6.09109667	0.050
	6	135.3111239	27.45034260	2.27962687	155.8540200	16.07657784	6.07637527	0.052
	7	135.5660110	27.48385842	2.28241021	156.0133371	16.08660616	6.08016562	0.053
	8	135.8055795	27.49340697	2.28320317	156.1406957	16.10091118	6.08557241	0.055
	9	136.0024805	27.52114376	2.28550659	156.2764029	16.13230995	6.09744003	0.056
	10	136.1667878	27.54103176	2.28715820	156.4100486	16.18074467	6.11574663	0.056
Deviation	1	31.6089927	10.37731414	0.86178903	31.2089386	8.17771668	3.09088638	0.920
	2	31.4520058	10.32891615	0.85776980	30.8363843	8.00177988	3.02438852	0.877
	3	31.1554626	10.29381994	0.85485522	30.6475200	8.17395880	3.08946603	0.898
	4	31.2711453	10.34187188	0.85884571	30.4715129	8.29049564	3.13351282	0.841
	5	31.2027498	10.34497031	0.85910302	30.3944043	8.50868609	3.21598105	0.839
	6	31.1005330	10.32576034	0.85750772	30.3165057	8.66131959	3.27367109	0.844
	7	31.5819366	11.55983913	0.95999239	30.2518243	8.78782378	3.32148518	0.765
	8	31.0323292	10.36960425	0.86114876	30.1991443	8.91417439	3.36924122	0.835
	9	30.9988406	10.36905312	0.86110299	30.1733129	9.01785132	3.40842742	0.836
	10	31.0513794	10.40834147	0.86436571	30.1827486	9.11795614	3.44626349	0.829
Entropy of Hdiff	1	1.5257865	0.10911401	0.00906143	1.5202071	0.07754101	0.02930775	0.894

	Pixel	IDC (n=148) Average	Standart deviation	Standart error	ILC (n=7) Average	Standart deviation	Standart error	Signifikansi
	2	1.6213262	0.11459042	0.00951622	1.6125686	0.07693016	0.02907687	0.842
	3	1.6791019	0.12226794	0.01015380	1.6695557	0.07801198	0.02948576	0.838
	4	1.7207762	0.12816197	0.01064327	1.7120586	0.08066301	0.03048775	0.859
	5	1.7530858	0.13349584	0.01108623	1.7447471	0.08343252	0.03153453	0.870
	6	1.7790535	0.13767171	0.01143301	1.7715600	0.08655722	0.03271555	0.887
	7	1.7974672	0.14557475	0.01208932	1.7942429	0.09061765	0.03425025	0.954
	8	1.8190492	0.14463779	0.01201151	1.8133386	0.09409468	0.03556445	0.918
	9	1.8348149	0.14744603	0.01224473	1.8293657	0.09614239	0.03633841	0.923
	10	1.8486772	0.15050684	0.01249891	1.8435843	0.09751869	0.03685860	0.930
Anguler second moment of Hdiff	1	0.0373317	0.00945719	0.00078538	0.0362171	0.00625452	0.00236399	0.758
	2	0.0301529	0.00819906	0.00068090	0.0297257	0.00492143	0.00186012	0.892
	3	0.0264829	0.00760508	0.00063157	0.0262943	0.00447068	0.00168976	0.948
	4	0.0241821	0.00738957	0.00061367	0.0239829	0.00421100	0.00159161	0.944
	5	0.0225104	0.00723454	0.00060080	0.0223143	0.00406143	0.00153508	0.943
	6	0.0212292	0.00709542	0.00058924	0.0210329	0.00390195	0.00147480	0.942
	7	0.0202617	0.00701517	0.00058258	0.0200086	0.00394125	0.00148965	0.925
	8	0.0194140	0.00691035	0.00057387	0.0190671	0.00394584	0.00149139	0.896
	9	0.0187663	0.00687225	0.00057071	0.0184157	0.00376733	0.00142392	0.894
	10	0.0181572	0.00679038	0.00056391	0.0178014	0.00369565	0.00139682	0.891
Mean of Hdiff	1	13.0044315	3.28830418	0.27307880	12.8764514	2.58576160	0.97732602	0.919
	2	16.3007437	4.35912747	0.36200583	16.0138443	3.47013242	1.31158677	0.864
	3	18.7080357	5.24950020	0.43594726	18.1383900	3.75149392	1.41793142	0.777
	4	20.6860886	5.98356049	0.49690765	19.8918086	4.10911592	1.55309983	0.729
	5	22.3636332	6.65117494	0.55235001	21.4161543	4.52950474	1.71199187	0.710
	6	23.8832428	7.25739935	0.60269421	22.7707043	4.91520935	1.85777451	0.689
	7	25.2233172	7.82210544	0.64959050	23.9815157	5.38847605	2.03665251	0.679
	8	26.4331844	8.35874188	0.69415573	25.0965229	5.79428972	2.19003566	0.677
	9	27.5453989	8.89030016	0.73829924	26.0930457	6.16308459	2.32942702	0.670
	10	28.5556697	9.39921379	0.78056222	27.0679543	6.53656128	2.47058794	0.680

Anova was conducted using IBM SPSS 20 software. The mean parameter is the only parameter that significantly distingguish IDC and ILC. At the mean analyis, the distance of 1-5 pixels are significantly distinguish IDC and ILC, while the higher distances are not sigificantly different.

The decision system of CAD that we developed can fall into one of the four categories. The image area can be called ILC and IDC and a decision can be true or false. The CAD system that we developed can produce two false output types, namely False Positive (FP) and False Negative (FN). True Positive (TP) and True Negative (TN) is the true decision. Two working measurements of classification system which are related with identified decision above are 'Sensitivity and Specificity'. Sensitivity (Recall) is TP/(TP+FN) whereas Specificity is TN/(TN+FP). The high values of sensitivity and specificity are very expected. 'Accuracy' and 'Precision' are also used to evaluate the performance of KNN system. Accuracy is (TN + TP)/(TP+FN+TN+FP) and Precision is TP/(TP+FP). Error Rate is (FP + FN)/(TP+FN+TN+TP).

To assess our algorithm, we examined 152 images from the data base of Dokter Soetomo Hospital, Surabaya, Indonesia. 145 (95%) images have IDC character and 7 (5%) images have ILC character. The results of our analysis are shown at Table 5.

Table 5 The Result of Analysis

Performance measure	IDC cases 145 (95%)		ILC cases 7 (5%)	
	TP 102 (70%)	FN 43(30%)	TN 5 (71%)	FP 2 (29%)
Sensitivity (Recall)		70 %		
Specificity		71 %		
Accuracy		70 %		
Precision		98 %		
Error Rate		30 %		

Evaluating of the performance of the CAD system that we developed to classify histopathology types of IDC and ILC needed the definite criteria to determine cluster detection of TP and FP. To evaluate our result, true classification cluster was identified by a radiologist and an expert of Pathology Anatomy. The criteria we used to calculate the number of TP detection, assuming that a detection cluster was true if the examination result from the radiologists and the experts of Pathology Anatomy (PA) was the same with the system decision of CAD that we developed. If the decision was assumed to be different, so it was assumed FP.

It was like shown at table 5, our algorithm, the sensitivity was 70%, the specificity was 71%, the accuracy was 70%, the precision was 98%, and error rate was 30%. Two radiologists and experts of pathology and anatomy found our result was quite satisfying and could be reliable.

4. CONCLUSION

The CAD system that we developed by using physics parameter was very helpful in classifying histopathology type of breast cancer. Mammogram image was very difficult to detect histopathology types. Even, the Radiology experts were not able to identify it for 100%.

The utilization of physics parameter to classify histopathology types of breast cancer helped the experts of Radiology to get the second opinion. The final aim of the CAD system that we developed for mammography was to detect untouchable lesion which its size was often neglected on mammography. Detection of histopathology type increased the opportunity for women to be successful in the treatment of breast cancer.

Our research was especially focused on histopathology types of IDC and ILC. We used physics parameter to classify histopathology types of breast cancer, after getting significant variable to distinguish histopathology types of IDC and ILC. Then, we used the parameter as the input variable of KNN method to take decision whether it included IDC or ILC histopathology types.

According to the experts of radiology, the result produced by the CAD system that we developed was quite satisfying and could be reliable, and could assist the expert of radiology in diagnosing breast cancer.

ACKNOWLEDGMENTS

The authors would like to thank for the assistance given during the research to: Directorate of Research and Community Service (DRPM) as the research funder. Prof.Dr.dr.Ketut Suastika,SpPD-KEMD (Rector of Udayana University, Bali), Prof.Dr.Ir. I Nyoman Gde Antara,M.Eng (Chairman of LPPM Udayana University, Bali), Drs. I.B. Suaskara,M.Si (Dean of FMIPA Faculty, Udayana University, Bali), Prof.Dr.dr.Sri Maliawan,SP.BS(K) (Chairman of Research Ethics Commission FK UNUD/RSUP Sanglah, Denpasar), Prof. Dr.dr.Triyono KSP,Sp.Rad(K) (Chairman of Radiology Department of RSUP Dokter Soetomo Hospital, Surabaya), dr. A.A.A.N.Susraini,SpPA(K) (Chairman of Pathology Anatomy Department of RSUP Sanglah Hospital, Denpasar Bali), dr. Bagus G. Dharmawan, Sp.Rad (Chairman of Radiology Department of RSU. Prima Medika Hospital, Denpasar, Bali), Wirabrata (Director of Human Resource and Education of RSUP Sanglah Hospital Denpasar, Bali), dr. Putu Dian Ekawati, MPH (President Director of RSU. Prima Medika Hospital, Denpasar, Bali).

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