ANDROID APPLICATION FOR DETECTION OF SKIN CANCER USING EXPERT SYSTEM

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ABSTRACT – Skin cancer is an abnormal growth of human skin that can damage skin cells. By knowing the symptoms of skin cancer as early as posssible, it is helpful in preventing the spread of cancer cells and treatment. There are many factors that cause skin cancer, but in general the cause is exposure to ultraviolet rays from the sun. Therefore, an expert system application is required to detect skin cancer. By using backward chining and probalility methode; which data is in form of someone's risk factor and clinical sympthoms, then the application will provide temporary diagnosis. This application is built in an android platfrom because in its development android is more used than other platforms. The accuracy obtained from this application is 96.67%.

Keywords: *Skin Cancer, Expert System, Backward Chaining, Probability, Android*

INTRODUCTION

Cancer is a disease caused by loss of cell ability to regenerate and grow normally. Cancer is one of the leading causes of death worldwide. In 2012 about 8.2 million deaths are caused by cancer. However, more than 30% of cancer can be prevented by altering risk factor for behavior and cancer causing diets (InfoDATIN, 2015).

Currently 132.000 skin cancer occur globally every year. 1 of 3 diagnoses of cancer is skin cancer. This is because the ozone is getting thinner and the sun's ultraviolet rays reach more of the Earth's surface. It is estimated that from 10% drop in the ozone level will produce 304.500 skin cancers. The main factors affecting skin cancer are exposure to sun rays and sun-exposed records (World Health Organization, 2016).

Based on a survey of 300 respondents, 86% said they did not care about skin changes, such as redness, bums and dark spots on the skin (benign tumors). This happens because of lack of information obtained by community. Over time the lumps or black spots will become more dangerous when the status turns into a malignant tumor (cancer) and spread throughout the body. Therefore before cancer cells spread, cancer must be known early, in order to have possibility for better treatment. Therefore, applications needed to detect skin cancer, in order to increase public awareness in recognizing the sympthoms and risks of cancer so it can determine the appropriate precautions and early detection.

On the other hand, it takes device as the cornerstone of the application, in this case the platform used is Android, because according to the Predicted Research Institute of Digital Marketing Emarketer in 2018 the number of active users of *smartphones* in Indonesia will be more than 100 million people. With that number, Indonesia will be the fourth largest *smartphone* user in the world after China, India and America (Ministry of Communication and Informatics, 2016), and also seen from the current android development, more than 50% of people in Indonesia use Android.

SKIN CANCER
According to Stockfleth et al. (2010), skin cancer is a disease in which the skin loses its ability to regenerate and grow normally. Healthy skin cells normally can divide regularly to replace dead skin cells and regenerate new skin. Abnormal cells can grow out of control and form cancer. The skin basically has three layers, namely epidermis, dermis and suklutis. Each layer is composed by cells.

Basal Cell Carcinoma (BCC)
This cancer originates from pluripotential epidermis cells, or from epidermis / there is neksanya. This cancers are commonly found in hairy areas, invasive area, rarely have scattered children (metastasis). It can damage the surrounding tissue, can even get to the bone, and tend to residifs more if the treatment is not strong. Basal cell carinoma generally grows slow, sometimes can develop rapidly. The most damaged network is on the surface. Ulceration may occur that radiates sideways or towards the base including muscle, bone or other tissues. Ulceration of the eye area can damage the eyeball until the orbit. In this last period, the shape of extensive rodent ulcers is somewhat rare. Early forms are more common, perhaps because of the influence of illumination through mass media (Carucci et al., 2008; Tan & Reginata, 2015).

Squamous Cell Carcinoma (SCC)
Squamos carcinomas cell derived from epidermal cells that have some degree of maturity, can be intraepidermal, can also be invasive and far metastasized. Clinical symptoms most commonly occur at the age around 40-50 years old (decade V – VI) with the most common localization in the lower limbs and is generally found more in males than females. This cancer can grow slowly, destroy local tissue with a small possibility of mentality. Conversely, this cancer can also grow quickly, damaging the surrounding tissue and far metastasized, generally through the lymph channels. At first this cancer is hard node with borderless boundaries, that surface is first slippery as a normal skin that eventually develops into hard, growing sideways as well as towards deeper tissues (Grossman & David, 2008).

Malignant Melanoma (MM)
Malignant melanoma is rare to be found, representing 1-3% of all malignancies. Incidence in women is almost the same as that of men with the highest frequency found at age (30-60) years old, rarely in children. Early forms are very difficult to distinguish from other cancers, because malignant melanoma is a fatal disease when it has distant metastases, the ability to recognize early malignancy needs to be deepened. Localization is reported to be most lower extremities, then in the area of the body, head / neck, upper extremities, nails (Tan & Dewi, 2015).

RESEARCH METHODS
Expert System
Expert systems or knowledge-based systems are applications that have some or all of the expert's expertise to solve problems. According to Merritt (2011), the main purpose of the expert system is not to replace the position of an expert, but to socialize the knowledge and experience of experts in their field. For example, expert system are used in diagnostic applications serving humans and machines. Expert systems are also used in game-based learning (Kamnardsiri et al., 2017), Internet of things (Hu et al., 2017), predict future share prices (Mehmanpazir, F., & Asadi, 2017), prevent cyber attacks (Anwar & Hassan, 2017), detecting credit card fraud (Behera & Panigrahi, 2017), human resource assessments (Bohlouli et al., 2017), diagnosing accidents by real time (Nicolau et al., 2017), land mapping (Gumbricht et al., 2017) and many other services that use expert systems.
Probability
Probability is the probability value for an event. Probability expressed in values from 0 to 1. 0 means imposibble and 1 means that event will 100% occur. The probability value of an event A is written in P (A). To calculate the probability of an event is by finding the number of incident members (x), then compared with the number of members of the sample space (n) (Pinheiro, 2012).

- Sum Rules
  1. Genesis Mutually Abolish (Mutual)
     When two or more events do not occur at the same time.

$$P(A \text{ atau } B) = P(A \cup B) = P(A) + P(B)$$
2. Genesis Does not Mutually Abolish
   When two or more events occur at the same time
$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$
- Multiplication Rules
  1. Free events
     Where the occurence of an event does not affect other events.
$$P(A \text{ dan } B) = P(A) \times P(B)$$
  2. Non-Free Events
     The event where the occurrence of an event depends on another event.
$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)} \qquad P(B/A) = \frac{P(A \cap B)}{P(A)}$$

Backward Chaining
Backward Chaining is an adjustment of facts or statements that start from a collection of hypotheses to the facts that support. So the process of tracking back and forth begins by determining the conclusion to be sought, then the processs of applying the premise for the rule as a new goal and new goal and looking for another rule with a new goal as a conclusion. The process continues until all possibilities are found (See Fig 1) (Kusumadewi, 2003).
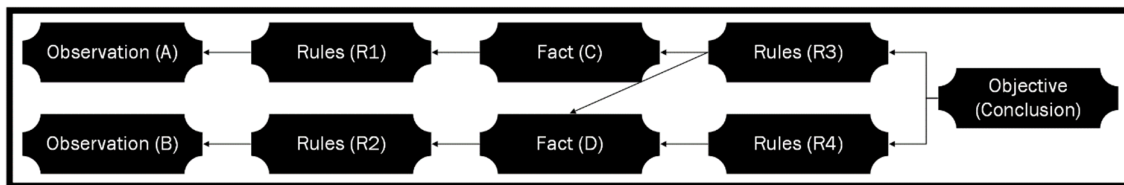

Figure 1: Process Backward Chaining.

Knowledge Representation
In the knowledge representation, obtained information from expert knowledge and literature. Representation of knowledge will be divided into 2 parts, namely risk factors and clinical symptoms.

1. Risk Factors and its Values
   In designing this expert system application, knowledge will be changed into the table. An expert gives a person a risk factor for skin cancer and its value.

<div align="center">Table 1: Risk Factors</div>

No	Variable	Variable type	Risk Value
1	Gender	Male	1.3
		Female	1
2	Age	10 - 29 years old	1
		30 – 39 years old	2
		40 – 49 years old	2.5
		50 – 59 years old	2.6
		60+ years old	2.9
3	Occupation	Jobless	1
		Student	0.5
		Employee	1.70
		Businessman	1.4
		laborer	1.4
4	Smoking in the last 1 month	Yes, it used to be	1.4
		Yes, sometimes	1.5
		Yes, everyday	1.6
		Don't smoke	1
5	Social Economics	Sallary less than Rp 3.000.000	1.2
		Sallary more than Rp. 3.000.000	1
6	Skin Color	fair	1.3
		Brown	1
		Dark	0.8
7	Number of Moles	0 - 5	1
		6 - 10	1.2
		More than 10	1.5
8	Low Immune	Yes	1.5
		No	1
9	Suffered from skin cancer before	Yes	2
		No	1
10	Family has skin cancer	Yes	1.5
		No	1

From Table 1 to get the result of risk value using the following formula:

$$N_{min} = \sum FR_{min}$$

$$N_{max} = \sum FR_{max}$$

$$\text{Risk Value} = \frac{(\sum FR - N_{min})}{N_{max} - N_{min}} \; x \; 100\%$$

Table 2: Formula description

Symbol	Explanation
N_{min}	Minimum Value
N_{max}	Maximum Value
FR_{min}	Minimum Risk Value
FR_{max}	Maximum Risk Value
NR	Risk Value
FR	The Real Risk Value

2. Clinical Symptoms of Skin Cancer
In this table, clinical symptoms of skin cancer will be differentiated into 3 types based on the type of skin cancer that often appears; Malignant melanoma, Basal Cell Carcinoma and Squamous Cell Carcinoma.

Table 3: Type of Skin Cancer

Disease Code	Type of Skin Cancer
P01	Malignant Melanoma
P02	Basal Cell Carcinoma
P03	Squamous Cell Carcinoma

The following table is the symptoms of skin cancer that often appear in humans.

Table 4: clinical symptoms

Symptoms Code	Clinical Symptoms
G01	Not symmetrical
G02	Uneven edes
G03	Striking Colors
G04	Diameter more than 6 mm
G05	Evolution (changing size / color / shape)
G06	Looks shiny and tight
G07	Redness / dry skin and itchingl
G08	The lump is shiny like a pearl
G09	Crusty curve in the middle
G10	Bloody open wounds
G11	Persistent / red scaly
G12	Growing high in the middle
G13	Open sores for weeks
G14	Resembles a wart

Table 5 describes each disease with some symptoms with '✓' sign, this explanation uses an adjustment of Symptom Code with the Disease Code.

Table 5: The Decision Table

Symptos Code	Disease Code		
	P01	P02	P03
G01	✓		
G02	✓		
G03	✓		
G04	✓		
G05	✓		
G06		✓	
G07		✓	
G08		✓	
G09		✓	
G10		✓	✓
G11			✓
G12			✓
G13			✓
G14			✓

RESULTS & DISCUSSIONS

This application serves to detect skin cancer from an early age and to provide information or increase public knowledge. Information provided in the form of introduction of skin cancer, skin examination, to the prevention of skin cancer. In addition, this application also features recommended location of the nearest cancer hospital if the user is really exposed to skin cancer. Besides there is also a shooting feature that serves to be sent to the doctor to prove a person really suffer from skin cancer or not, after proven, user can make an appointment to see a doctor. In this application, there is an alarm feature which functions as a reminder when user has made an appointment with a doctor (See Fig 2)

The testing of this application was done at one of cancer hospital in Jakarta with 30 participants who suffer from skin cancer. The results of the experiment was 29 people successfully detected and 1 person was not detected. Once being re-evaluated for the error occured, it takes some additional risk factors such as neighborhood, food to eat, and several other factors. So, the more risk factors, the higher the level of accuracy of the application to detect skin cancer.

CONCLUSIONS

Information about skin cancer should be socialized to public in order to prevent the outbreak of skin cancer by knowing the symptoms and forms of skin that suffer from skin cancer. With this application, early detection can be done easily by everyone using Android smartphone. If the diagnosis is positive, user is advised to consult a specialist. This application alse ease doctors to treat and cure skin cancer patients, because the cancer rate is still low. The accuracy of this application is 96,67%.

Figure 2: Application of Skin Cancer Detection

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