

## Expert System of Quail Disease Diagnosis Using Forward Chaining Method

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### Abstract

Expert system applications were in great demand in various circles since 1950, with a coverage area that was large. Expert System on the organization was aimed at adding value, increasing productivity as well as the area of managerial can make decisions quickly and accurately. Neither with organizations that did business quail, which was very promising, but needed to be alert for the presence of disease in quail healthy, as in the case in birds quail were highly vulnerable to various kinds of diseases caused by viruses or bacteria. the benefits of the expert system that was able to diagnose quickly and accurately to the symptoms of the disease caused was expected to helped the farmers in of anticipation the many losses caused by disease. Required accuracy and the accuracy of the counting in diagnosing the symptoms of the disease in order to summarized the results by using forward chaining method.

**Keywords:** expert system, disease quail, method forward chaining

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### 1. Introduction

Science artificial intelligence has been a topic for research since 1950 and expert systems is desirable because the area this application promises range of applied fairly wide area Tsai at all., 1994; Sung J. Shim, 1999. According to the ability that can be developed from this system, the degree of use of an expert system for the organization can be emphasized as the proper function between expectation and realization of the benefits derived from their use. Some examples of research that is relevant to the implementation of an expert system with theof influencethe organization are generally more stressed in three areas, namely adding value, increasing productivity, and managerial areas. Area value additions include improving decision-making and reporting in consistency, accuracy and time constraints, improved service, and customer and competitive and market share improvement. The area includes the benefits of productivity of improved production cost and processing time, employment increased creativity, and reduce tasks routine as well as the area increased managerial control and improvement in terms of education and training Durkin, 1996; Sung J. Shim, 1999.

Applying of an application is generally aimed at the problems that tend to want to get the solution of the results of such consultations, diagnosis, estimation, prediction and the like. As with any application in medicine or the medical world, consulting, and diagnosis is unreliable because the results of this diagnosis can anticipate some kind of disease accurately and quickly. Likewise with organizations engaged in the effort to develop business, the livestock certainly are expecting the area of value addition, productivity and managerial ready for human the diagnosis of disease affecting livestock precisely and accurately so that losses can be prevented.

Some time ago an outbreak of the disease to poultry the quail are very detrimental for

entrepreneurs poultry farms not least because the quail harusdimusnahkan, which caused the spread of communicable diseases. Poultry quail is kind of livestock quail bird groups are used for meat or eggs, which increased its customers every day. Therefore, efforts quail is a very good opportunity for business. But, in this venture disease is one of many risk that high and should always be faced. Anticipation for preventing and recognizing the symptoms of a dangerous disease is very important. The process to identify quickly and accurately from the attack of diseases is difficult because the symptoms caused generally similar and the same. However, usually there are some typical symptoms for each type of disease in livestock quail. The disease can be caused by a virus attack or bakteri. The following will describe the application of expert system applications that can perform a diagnosis of poultry diseases quail with forward chaining method.

Artificial intelligence is an information system related to the disclosure, modeling, and storage of human intelligence in a information technology system so that the system have intelligent as humans Kusumadewi, 2003; Miharadi, 2009. The system was developed to develop methods and systems to solve problems, usually solved through human intelligent activity such as image processing, planning, analyzing, and even to improve performance computer-based information systems. As one of the common and more widely applied into the application is an expert system.

Expert systems are generally defined as a system designed to model the ability to solve problems like an expert human expert. The component that must be met within the category of expert systems is as follows.

First, the knowledge base. The knowledge base is the core program of expert system, the representation of knowledge knowledge representation of an expert. The knowledge base consists of the fact that the form of information on how to generate new facts from the facts already known. Database is the part of containing all the facts, whether the facts early on when the system starts operating, as well as the fact that can be got when the process is concluded. This database is used to store data observation and the other that required during processing.

Second, the inference engine. The inference engine is the part that contains the mechanism of function of thinking and patterns of reasoning systems used by an expert. This mechanism would analyze a particular issue and will seek the best answer or result. In deductive inference engine selecting relevant knowledge in get result order. Thus, the system can answer the question from user, even though the answers are not stored explicitly in the knowledge base. Inference engine start tracking by matching the rules in the knowledge base with the facts that there. There 2 type inference techniques, namely:

1. Trace behind Backward Chaining. Trace behind a search strategy which is directed opposite of trace forward. The search process starts from the goal, the conclusion to be the solution of problems faced. Looking inference engine rules in the knowledge base, the conclusion is a solution to be achieved. Then, from the rules obtained, respectively conclusion traced back pathway that leads to that conclusion. If the information or the value of the attributes that led to the conclusion that according to the data provided, the conclusions of such a solution is sought. If it is not, then the conclusion is not a solution is sought. Trace back start the search process a for purpose so this strategy also called goal-driven,
2. Trace forward Forward Chaining. Breadcrumb developed a search strategy which the process initiated of collection of data or facts. From these data, sought a conclusion that a solution of the problems faced. Inference engine looking for to the rules in the knowledge base that premise is in accordance with these data. Then, from the rules obtained a conclusion. Advanced trace start the search process with the data that the strategy also called data-driven.

Third, the user interfac. The user interface is part of link the between expert system with the user program. In this section, there will be a dialogue between the program and the user. The program will ask questions with answers in the form "YES or NO" Yes or No Question or a menu choice. Furthermore, conclusions are drawn based on the answers of the user.

Of the benefits that can be derived based on expert system categories, were 1 interpretation, making inferences or description of a set of raw data; 2 Predictions, projecting the possible consequences of a given situation; 3 Diagnosis, determine cause malfunctions in the situation based on the symptoms observed; 4 Design, determine the configuration of the system components that match specific performance objectives that meet certain constraints; 5

Planning, planning a series of actions to achieve a number of objectives with specific initial conditions; 6 Debugging and repair, and interpretation determine how to cope with malfunctions; 7 Instruction, detecting and correcting deficiencies in the understanding of domain the subject; 8 Control, regulate the behavior of a complex environment; 9 Selection, identifying the best choice of a set of possibilities; 10 Simulation, modeling the interaction between the components of the system; and 11 Monitoring, comparing observations with conditions the expected Turban, 2005.

The main modules contained in the expert system are 1 reception module knowledge Knowledge Acquisition Mode. This module is used to gather knowledge that will use the system in the conclusion of a problem. This module is for experts to re-input-relevant knowledge into the system; 2 Module consultation Consultation Mode. Module serves to collect information about the symptoms of the problem being faced by the user, and then processed by the system. This module is for user to input the problems it faces into the system; and 3 an explanation Module Explanation Mode. This module serves to explain the decision taken by the system Russell, 2003

## 2. Methodology

The method used in this study refers to the application of system development process expert are common. Emphasis is made on the process of problem identification and analysis of the design and testing of applications, documentation and maintenance. Nair et al, 2004. The fulfillment of the concept of expert system knowledge base is done by collecting data and information related diseases of poultry quail, with a literature study and consultation with breeder an experienced quail. The concept of Inference Engine is done with the use of Production Rule IF, AND, THEN the mechanism through Forward Chaining. The concept of user interace and developed dialogue with manufacture interface Friendly user for ease of charging data and facts. Output is presented in the form of information a confidence value diagnosed diseases attack the quail, while the validity of the test results are comparative with expert Quail Farmer. In addition, the development application tools used JAVA as language in construction.

### 2.1. QUAIL

In terms of foreign quail called quail bird which is the nation liar. In Indonesia, especially in Java quail called "Grease". Quail is one bird species can not fly, has a relatively small body size, have short legs, can pitted and be cannibal. Initially, quail is a bird liar. At 1870 in the United States quail began farmer. After that period, the quail became known and bred in end of the 1979. The nutritional value of quail eggs are not inferior to other poultry thereby increasing the supply of protein sources animal and give consumers a lot of choices Listiyowati and Roosпитasari, 2005.

Murtidjo 1996 suggest that the protein and fat content quail eggs is quite good when compared to eggs other poultry. High protein content, but the fat content is low so it is good for health. Differences in protein and fat composition of quail eggs compared with eggs of other birds are listed in Table 1.

Table 1. Differences in protein and fat composition of quail eggs compared with eggs of other birds

No	Poultry Type	Protein %	Fat %	Carbohydrates %	Ash %
1	Chicken race	12,7	11,3	0,9	1,0
2	Free-range chicken	13,4	10,3	0,9	1,0
3	Ducks	13,3	14,5	0,7	1,1
4	Geese	13,9	13,3	1,5	1,1
5	Pigeons	13,8	12,0	0,8	0,9
6	Turkeys	13,1	11,8	1,7	0,8
7	Quail	13,1	11,1	1,6	1,1

Source: NRC 1984.

Classification according quail Editors Agromedia 2002 are as follows:

Class: Aves the birds

Order: Galliformes Sub

Order: Phasianoidae

Family: Phasianidae  
 Sub Family: Phasianidae  
 Genus: Coturnix  
 Species: Coturnix-Coturnix japonica.

Excess livestock quail compared with other poultry by Sutoyo 1989, are follows: Livestock quail very easy maintenance, does not require a lot of effort and cost that much / great. Not many places seized, can accommodate 100 quail children tail / m<sup>2</sup> aged 1-10 days and 60 birds / m<sup>2</sup> for quail aged over 10 days. Quick spawn, so thefor need eggs family quickly met.

## 2.2. Disease QUAIL

From the test results of data there are 9 types of illness quail at the big picture that is as in the following Table 2:

Table 2. Quail Disease

No	Disease's Name	Causes	Symptoms	Control
1	Enteritis Quail enteritis	Bacteria anerobik forming spores and invade intestine, causing inflammation of the intestine.	Quail looked lethargic, eyes closed, feathers forming spores and looks dull, invade the intestine, feces causing form spores and inflammation invade the intestine, bowel, causing inflammation of the intestine.	More attention to maintenance in cages and poultry, as well as separate quail healthy and sick.
2	Tatelo NCD / New Casstle Disease	ND Virus	Quail difficulty breathing, coughing, sneezing, sounds arise snoring, lethargic, sleepy eyes, sometimes bloody, stool watery greenery, which is in the know of this phenomenon is the head of the play - rolling and paralyzed.	Maintain cleanliness and cleaning equipment affected by the virus, quail that died immediately in the fuel / discarded. and prevent the guests went into the cage, try to be sterile.
3	Salmonella bacteria/ White pullorum	Salmonella bacteria pullorum is infectious diseases.	Stools white, loss of appetite, shortness of breath, feathers shrivel and wing hanging off.	Just like disease totelo, cleanliness should be in guard and avoid incoming guests to the cage.
4	Tools Bloody Coccidiosis	Parasit	Tools bloody, loss of appetite, dull hair, shivering.	Maintain cleanliness and litter remains dry. or by Tetra Chlorine given mouths, noxal, trident Zuco tablet dissolved into drinking water.
5	Smallpox Poultry Fowl Pox	Poxviruses are attacking the nation's poultry of all ages and all kinds of quail	Arise Kopen in part hairy, like wattles, feet, mouth which if released would bleed.	vaccine diphtheria and separate quail infected
6	Quail Bronchitis	Quail Bronchitis Virus is highly contagious	Quail looked lethargic, dull hair, trembling, contagious, coughing and sneezing, eye and nose sometimes mucus, and sometime head and neck slightly twisted,	Nutritious and good sanitation.
7	Aspergillosis	The fungus Aspergillus fumigatus	Quail have breathing problems, in the eye is made layer like cheese, drowsiness and decreased appetite.	Improving sanitation and environment.
8	Wormy	Wormy poor sanitation	Quail looks emaciated, lethargic and weak.	Cleaning cages as well as giving a good feed.
9	Snot/Coryza	Weather Changes	This is a disease affecting the eyes, quail who is struck this disease eyes will be red, swollen and slimy.	Should be treated to prevent the use of vaccine CDR / coryza in active or inactive, if quail are already infected with diseases such as discarded, although there is treatment through special injections but at a costly price.

Table 3. Code of Quail Disease, Causes, Symptoms, and Control

No.	CODE of disease's name	CODE of Cause	CODE of Symptoms	CODE of Control
1	A01	B01	C01	D01
2	A02	B02	C02	D02
3	A03	B03	C03	D03
4	A04	B04	C04	D04
5	A05	B05	C05	D05
6	A06	B06	C06	D06
7	A07	B07	C07	D07
8	A08	B08	C08	D08
9	A09	B09	C09	D09

**3. Method of Forward Chaining**

The main part of an expert system is a knowledge base. Knowledge base is place to save the rules and as central data of the different type that can be access. Istiadi et al, 2016. In this research, we use forward chaining method to process the knowledge base.

Forward Chaining method is a method of searching or tracking techniques ahead which starts with the existing information and merging rule to produce a conclusion or goal. Russell S, P Norvig, 2003.

Forward Chaining is a search technique that starts with the known facts, then match these facts with the IF part of the rules IF\_THEN. If there is a fact is matched with IF. So the rule is executed. When a rule is executed, then a new fact THEN part added to the database. Every rule should only be executed once. T. Sutojo, et, 2010.

The expert system is a computer program representing and reasoning with the knowledge of one's subject matter expert with a view to solve problems or provide suggest. Human expert is someone which has amastery deep of problem. Based on experience, human experts to develop the ability to solve problems more efficiently and effective. Expert system should also be able to explain the reason of each step in achieving a goal and answered questions about the solution reached, just as someone human experts. Riskadewi et al, 2005.

The forward chaining expert system-based rules can be modeled as shown below:

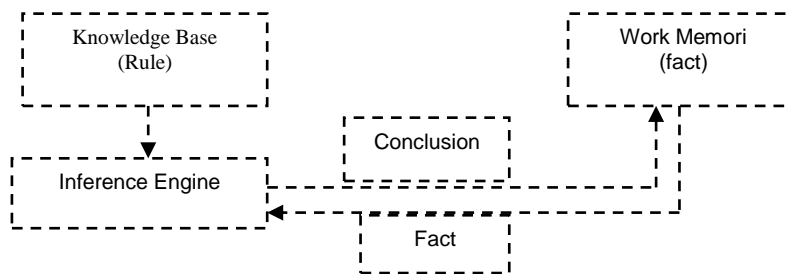


Figure 1. Model Based Rules

**Rule as Engineering Knowledge Representation**

Each rule consists of two parts, are follows: the IF-called evidence facts and THEN part called the hypothesis or conclusion. Sutojo T., et 2010. Syntax Rule is:

**IF E THEN H**  
**E : EVIDENCE (facts)**  
**H : hypothesis or the conclusions**

In general, evidence rule has more than one connected by the conjunction AND or OR, or a combination of both. But you should make it a habit to avoid the use of AND and OR at once in a single rule.

<b>IF (E1 AND E2 AND E3 ..... AND En ) THEN H</b> <b>IF (E1 OR E2 E3 ..... OR En ) THEN H</b>
--

The evidence can also have more than one hypothesis.

<b>IF E THEN ( H1 AND H2 AND H3 ..... AND Hn )</b>
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#### 4. Results and Discussion

The expert system has three main parts, are follows: The knowledge base the place to save the actual information, inference engine the reasoning process to search for solutions and concluded that the data sent by the user and the facts stored on knowledge base, and user interface screen menu offerings for expert systems are communicated by user Duval et al., 1994. Knowledge base can be a data structure that is stored in the form of the tables that are related between each other. The data related to symptom and cause disease in quail are stored here.

In the inference engine, used form of production rules. Generally, a rule consists of premise and a conclusion or a situation and an action. Expressions used in the writing are IFTHEN. Relationship "if-then-else" is an imitation of the way an expert to find the cause and achieve expert level results in solving difficult problems. An expert system must move the thought process of a pattern of an expert scientific and art into several parties recognize that this opportunity is very potential to be used in achieving competitive. Since 1970, growth occurred expert system of the medical world into taxation and other fields. The system is very successful to keep the difference between skill and knowledge of an expert. This application has penetrated more widely, for example in the field of education and training or consulting facilities that help employees to improve performance with faster and more consistent Tsai et al., 1994. It is expected that farmers can also be faster to have knowledge and experience in identifying and treating the type of disease to their quail livestock.

Some issues were selected for the sample in this diagnosis is done by determining the types of diseases that can affect livestock quail, accompanied causes, symptoms, and control posed as in Tables 2 and 3. In particular, problem is posed fully evaluated and determined compliance. Tracking mode and reasoning are determined using a Forward Chaining mechanism. For each type of disease, causes, symptoms, and control posed, made code with A01...A0n, B01...B0n, C01...C0n, and D01...D0n. Each symptom is given control according to the acquired reference table 3.

As for the part of the user interface that displays the menu offerings are given some kind of symptoms that can be selected. Users can determine the symptoms observed in quail livestock. Input this phenomenon is the premise for the reasoning to be performed on Knowledge Base with rule production that has been constructed. In general, expert systems are developed use LISP language or Prolog Tsai et al., 1994. However, along with the development of tools that can be used for the development of expert systems, some tools have been available widely with the diversity and convenience offered winexsys, shell, and so on. Construction tools language used in this study is Java.

##### 4.1. Method of Forward Chaining

Inference engine is the part that contains the mechanism of function patterns of thinking and reasoning systems used by an expert. This mechanism would analyze a particular issue and will seek the best answers or conclusions. Inference engine start tracking by matching rules in the knowledge base to the facts in the database. There are two techniques inference that there is tracking backwards Backward Chaining who started reasoning from hypothesis towards fact conclusions containing this hypothesis. And the second that is traced forward Forward Chaining which is the opposite of tracking backward ie start of a set of data towards the conclusion.

The forward chaining expert system-based rules can be modeled as shown in Figure 2:

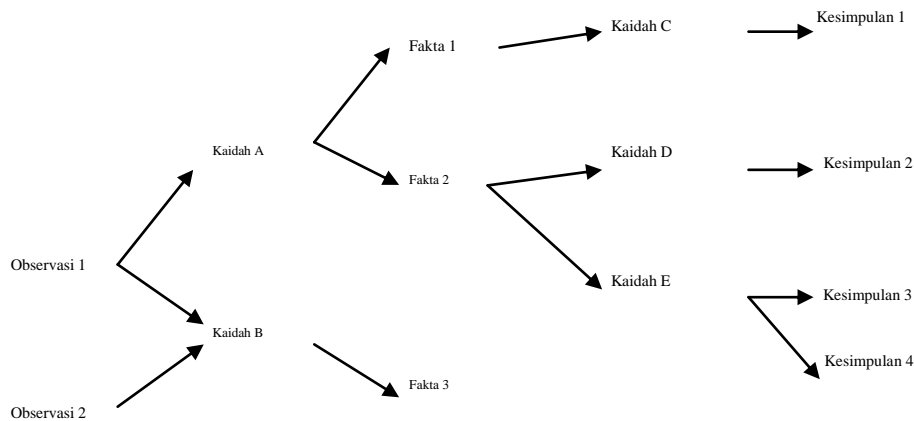


Figure 2. Diagram Tracking Forward Forward Chaining

**4.2. Rule as Engineering Knowledge Representation**

Each rule consists of two parts, are follows: the IF-called evidence facts and THEN part called the hypothesis or conclusion. Sutojo T., et 2010. Syntax Rule is:

**IF E THEN H**

**E : EVIDENCE facts**

In general, evidence rule has more than one connected by the conjunction AND or OR, or a combination of both. But you should make it a habit to avoid the use of AND and OR at once in a single rule.

**IF E1 AND E2 AND E3 ..... AND En THEN H**

**IF E1 OR E2 E3 ..... OR En THEN H**

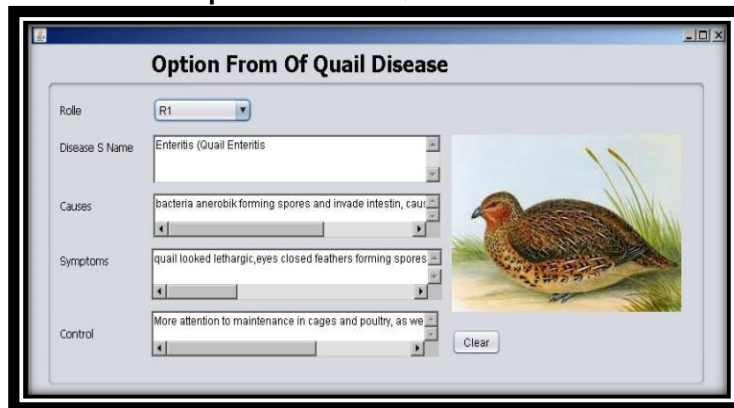
The evidence can also have more than one hypothesis.

**IF E THEN H1 AND H2 AND H3 ..... AND Hn**

Table 4. Knowledge Base Rule: IF - THEN Quail Disease Diagnosis

No	Rule	List of Rule IF – THEN
1	R-1	A01 AND B01 AND C01 THEN D01
2	R-2	A02 AND B02 AND C02 THEN D02
3	R-3	A03 AND B03 AND C03 THEN D03
4	R-4	A04 AND B04 AND C04 THEN D04
5	R-5	A05 AND B05 AND C05 THEN D05
6	R-6	A06 AND B06 AND C06 THEN D06
7	R-7	A07 AND B07 AND C07 THEN D07
8	R-8	A08 AND B08 AND C08 THEN D08
9	R-9	A09 AND B09 AND C09 THEN D09

**Option Form of Quail Disease**



## 5. Conclusion

The expert system is the science being developed since 1950, whose application has been very extensive, especially for organizations who expect increased value, productivity, and managerial ability in decision decision. Poultry expert system in the world an as important element to excellence in making a diagnosis orthat anticipation treatment can be done more precisely and accurately. The three main parts that is characteristic of systems, there are *expertis the Knowledge Base, Inference Engine, and User Interface*.

The diseases that attack quail is helping farmers in anticipation the symptoms caused to treatment quickly, accurately, and efficiently. This can reduce the losses which can be caused by spreading the disease which is now likely to be dangerous. The rancher can increase productivity by detection of early disease.

The advantage of the application of expert system for diagnosis of the disease is dependent on the results of the calculation of the level of confidence in supporting the process of inference to data and facts store on the Knowledge Base. Forward chaining method can provide accurate results from the conclusion of the resulting diagnosis. Use of Forward Chaining method is very easy with the determination of the Rule, and calculation based on facts that appear as a symptom. Things to consider in this Forward Chaining method to the symptoms caused will affect the magnitude of the conclusions obtained. Do not rule out the possibility for further development by a combination of rule more complex so that the complexity of the diagnosis can provide more satisfactory results.

## References

- [1] Durkin J. Expert systems: A view of the field. *IEEE Expert*. 1996; 112: 56-62.
- [2] Dimas Panji Widjanarko, Sistem Pakar Penditeksi Dini Penyakit Pada Burung Puyuh.
- [3] Duval BK and Main L. Expert systems: What is an expert system. Library Software Review, Westport: Spring. 1994; 131, 44, 10 pgs.
- [4] Kulkarni AD. Computer vision and fuzzy-neural systems, New Jersey: Prentice Hall. 2001.
- [5] Kusumadewi S. Artificial intelligence, Yogyakarta: Graha Ilmu. 2003.
- [6] Siti Rohajawati, Rina Supriyati. Diagnosis Penyakit Unggas.comMIT. 2010.
- [7] Mhradi. Kecerdasan-buatan. 2009. Diakses 5 Juli 2010, dari <http://silvercyber19.blogspot.com/search/label/About%20IT>.
- [8] Price JD, Malley JC and BalsmeierPW. Expert systems: Application to inventory control and production management. *Industrial Management*, 1994; 365: 26, 5 pgs, Norcross.
- [9] Rasyaf. Panduan beternak ayam petelur, Jakarta: Swadaya. 2009.
- [10] Russel S and Norvig P. Artificial intelligence: A modern approach, 2<sup>nd</sup> ed., New Jersey: Pearson Education. 2003.
- [11] Shim SJ. Exploring the benefits of expert systems use in organizations. *The Journal of Computer Information Systems*. 1999; 393: 77, 4 pgs, Stillwater: Spring.
- [12] Tsai N, Necco CR and Wei G. Implementing an expert system: A report on benefits realized part 1. *Journal of Systems Management*. 1994; 4510: 26, 5 pgs, Cleveland.
- [13] Turban E, Aronson JE and Liang TP. Decision support systems and intelligent systems, 7<sup>th</sup> ed., New Jersey: Pearson, Prentice Hall. 2005.
- [14] B Herawan Hayadi. Sistem Pakar. Deepublish, Jogjakarta. 2015.
- [15] Nair, Vikneswarn et. Al. Applying the expert system technology to evaluate ecotourism sites based on safety, health and environmental quality assurance. *The Journal of Hospital Tourism*. 2003; 11: 11 pgs, Malaysia.
- [16] Istiadi et al. An online expert system for consultation services using a mobile application interface. *Jurnal Teknologi*. 2016; 78: 6-3, 5 pgs, Malaysia.