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Psychiatric Outreach Expert (Rule-Based System)

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***Abstract*– This paper presents a Psychiatric Outreach Expert system. It is used to know if the applicant needs the services of the "center for psychiatrically impaired elderly". It also evaluates the regular patients to determine if they are still appropriate for the services rendered by the center. The language of implementation is the SWI-Prolog. Facts and rules were formulated from the knowledge acquired from the human expert. This paper therefore, discusses the task the Psychiatric Expert System (PES) performs, the problem-solving paradigm involved, the knowledge contained in the system, and the lessons learned from designing and building the system. In addition, it highlights some future works to be done to make the project more standard.**

***Index Terms*– Psychiatry, Psychiatric Expert System and Human Expert**

I. INTRODUCTION

THE expertise in psychiatry could be traced to Ancient India. During the 5th century BCE, mental illnesses, especially those with psychotic characteristics were seen as supernatural in origin [1]. This view had existence throughout Ancient Greece and Rome. The background of psychiatry as a medical field is dated to the middle of nineteenth century [2].

Problem solving in psychiatry usually involves an interview between a clinician and a patient. The essence of this is to gather pertinent data. Although medical technology has advanced tremendously in recent and has increased the amount of laboratory and neuroimaging information available to assist psychiatrist in making more accurate diagnoses and developing more specific treatment plans for patients, these tests cannot replace the importance of gathering critical data via the traditional psychiatric interview.

The behaviour of psychiatric patients is a significant problem that researchers are trying to solve. In some cases, their behaviours could be assaultive from cocaine abuse to possession of guns at home. One of the cures is checking on a psychiatrist to give advice/or medications [3] for effective management. However, research has also shown that each year, almost one in four public psychiatric nurses suffers a disabling injury from a patient assault; hence, it is seen as one of the most dangerous occupations for work-related injuries [3]. The significant problems psychiatry inpatients pose range from staff injury to use of seclusion and restraints.

In the meantime, Expert System is a sub-field is one of the branches of applied computer science – Artificial Intelligence. It is also defined as an assembly of programs that manipulate knowledge to solve problems in a particular domain that requires human expertise. It is also known as knowledge based system.[4]. In this paper, the problem domain is psychiatry. In an ES, the main mechanisms consist of the knowledge base and inference engine. The knowledge base usually contains the field knowledge, which is required to solve the problems in the form of rules. These rules are examples used for knowledge representation [4]. The architecture of a KBS consists of the Knowledge Base, Inference Engine, Knowledge Acquisition sub-system, Explanation sub-system and the User interface [5]. Other ways to represent knowledge include: Semantic Nets, Frames, Scripts, Object Orientation, KRYPTON, conceptual graph and Logical representation [6].

II. PROBLEM STATEMENT

Patients usually connect the most important aspect of their illnesses to their physicians during the doctor-patient interview. The psychiatrist listens and then responds to the patient in an effort to understand the patient's problems in the context of the patient's culture and environment [7]. The psychiatric interview is similar to the general medical interview in that both include the patient's chief complaint, history of present illness, past history, social and family history, and review of systems. However, the psychiatric interview differs from the traditional medical interview because the psychiatric interview also includes a more thorough examination of the patient's history; include the patient's feelings about important life events and exploration of the patient's significant interpersonal relationships, patterns of adaptation, and character traits [7]. The psychiatric interview includes a formal examination of the patient's mental status as well.

Connecting with a patient and gathering pertinent data via the psychiatric interview requires considerable preparation and practice. Psychiatric interview requires considerable preparation and practice. Psychiatric interviewing is a skill founded on extensive knowledge of normal and abnormal human behaviour [7].

It is optimal for a training psychiatrist to observe others interviewing many patients and to be observed and critiqued while interviewing many patients before practicing independently. In medical education, such observation and supervision should occur often during both medical school and psychiatric residency training. Optimally, similar observation opportunities should continue throughout one's professional practice of psychiatry.

Considering the need to ward off emotional/psychiatry problems from the society, homicide, murder and so on, a lot of researches have been conducted. However, some citizens do not know whether they should go for a psychiatry consultation. For instance, some people feel like consuming hard drugs without considering the implications. Therefore, this research has the following aim and objectives:

III. AIM AND OBJECTIVES

The aim is to develop a psychiatric outreach expert system. The specific objectives are:

- ✓ To evaluate referrals
- ✓ To determine if the applicant needs the services of the centre
- ✓ To check if the patient is still appropriate for the services rendered by the centre.

Knowledge-based expert systems have been very successful consulting applications in several fields, including medicine.

IV. METHODOLOGY

A) Scope

This research is limited to the system - patient interview. Our proposed system does not change with the environment. The language of implementation is the SWI-PROLOG.

B) Definition of the Task

The general task of the system consists of two parts:

i). Determine whether the applicants need to consult a psychiatrist.

ii). To determine if the applicant needs the services of the center for psychiatrically impaired elderly.

The program gives the appropriate response to answer the queries posed by the user. There are lots of psychiatric symptoms. The occurrence lies in young-adolescents and adults. For example if a person was has low economic status, then he or she has need to after an accident and was brutally injured in the head, the consult a psychiatric doctor. Also, drinking under influence/or smoking is also another symptom of psychiatry. Once the user logs on there would be immediate check for psychiatry status. These are implemented in forms of rules and facts in SWI- Prolog.

C) Encoding

PES allows a computer to act as a doctor and to properly diagnose and recommend actions for patients with psychiatric illness. Rules permit knowledge and reasoning to be represented explicitly. This information is easily and directly encoded in an *IF X THEN Y ontology.*

D) Knowledge Acquisition

How does the System know it?

The process of knowledge Acquisition is very important. It often consists primarily of what N.J.
Cooke calls “unstructured interviews,” “active participation” and “structured participation” [8]. In this paper, it started with collecting an introduction letter from the department, which was submitted for scheduling an interview with the experts in University of Ibadan and reading literature on psychiatry.

To solve a problem in the field of psychiatry, there is usually a need to schedule an interview between a clinician and a patient. The essence of this is to gather pertinent data. This important aspect was carried out by consulting literatures on the subject, because consulting a medical expert was quite costly. The stage at which knowledge is being captured is not the hardest part in knowledge engineering, but how to construct the knowledge Representation.

The knowledge acquisition process consumed 50% of the project.

E) Coding

Notepad is used to create the database for the SWI Prolog. It provided the enabling environment to quickly input codes up to infinity. It is available on every Microsoft Windows operating system by default. The use of SWI-Prolog as an expert system tool made development of the program easier as some codes used were subset of the problem, allowing us to focus on the knowledge of the system. SWI Prolog facilitates using backward chaining method as a reasoning instrument.

Sample Codes

```
Disease (patient, psychiatry):
Symptom(patient, bad_mood),
Symptom(patient, depression),
Symptom(patient, nervousness).

Recommendation (patient, psychiatrist):
Symptom (patient, head_injury),
Symptom (patient, aggresson_towards_family_members),
Unhappy (patient),
Marital conflict (patient),
Symptom(patient, fear),
Symptom(patient, anxiety).
Symptom(patient, anger),
Symptom(patient,violent_behaviour),
Symptom (patient, harm),
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Symptom(patient, aggressive_behaviour),
Symptom(patient, bad_mood),
Symptom(patient,eating_disorders),
Symptom(patient,bulimia_nervosa),
Symptom(patient, binge-eating disorder),
Symptom(patient, dementia),
Symptom(patient, feeling_sad),
Symptom(patient, confused_thinking),
Symptom(patient, reduced_ability_to_concentrate),
Symptom(patient, excessive_fears),
Symptom(patient, withdrawal_from_friends),
Symptom(patient, nicotine_dependence),
Symptom(patient, neurone_malfunction),
Symptom(patient, neurone_synapses),
Symptom(patient,abuse_of_mind_altering_substances).

According to Table I, the rule states:

- logon(user): The system fires the facts associated with this rule. If the conditions are true then the system outputs "Welcome to the ALAPO PSYCHIATRIC EXPERT SYSTEM Interface" and "PROGRAMME DEVELOPED BY ABDULHAMEED IDRIS ADEDAMOLA
- info(supervisor): The system fires the facts associated with this rule. If the conditions are true then the system outputs "SUPERVISOR: DR. (MRS) BF OLADEJO"
- consult(kbs1)**:** This is a function to simply check whether a client is expected to see a psychiatrist or not. The system fires the facts associated with this rule. If all the facts are logically true then the system writes "You are advised to see a psychiatric doctor". The flowchart below illustrates how the Psychiatric Expert System (PES) works:

Table I: Showing Input-output in the proposed PES

INPUT	OUTPUT
logon(user)	Welcome to the Expert System MATRIC NUMBER: 181962
info(supervisor)	SUPERVISOR: DR. (MRS) BF OLADEJO
p(fatigue,p001,08026248258,seeYourDoc).	TRUE
p(fatigue,p001,08026248258,A).	A = seeYourDoc
p(fatigue,p001,P,seeYourDoc).	P = 08026248258
consult(kbs1)	You are advised to see a psychiatric doctor
consult(kbs2)	You are OK Sir/Ma Pls go home
consult(kbs3)	Please relax until you are OK

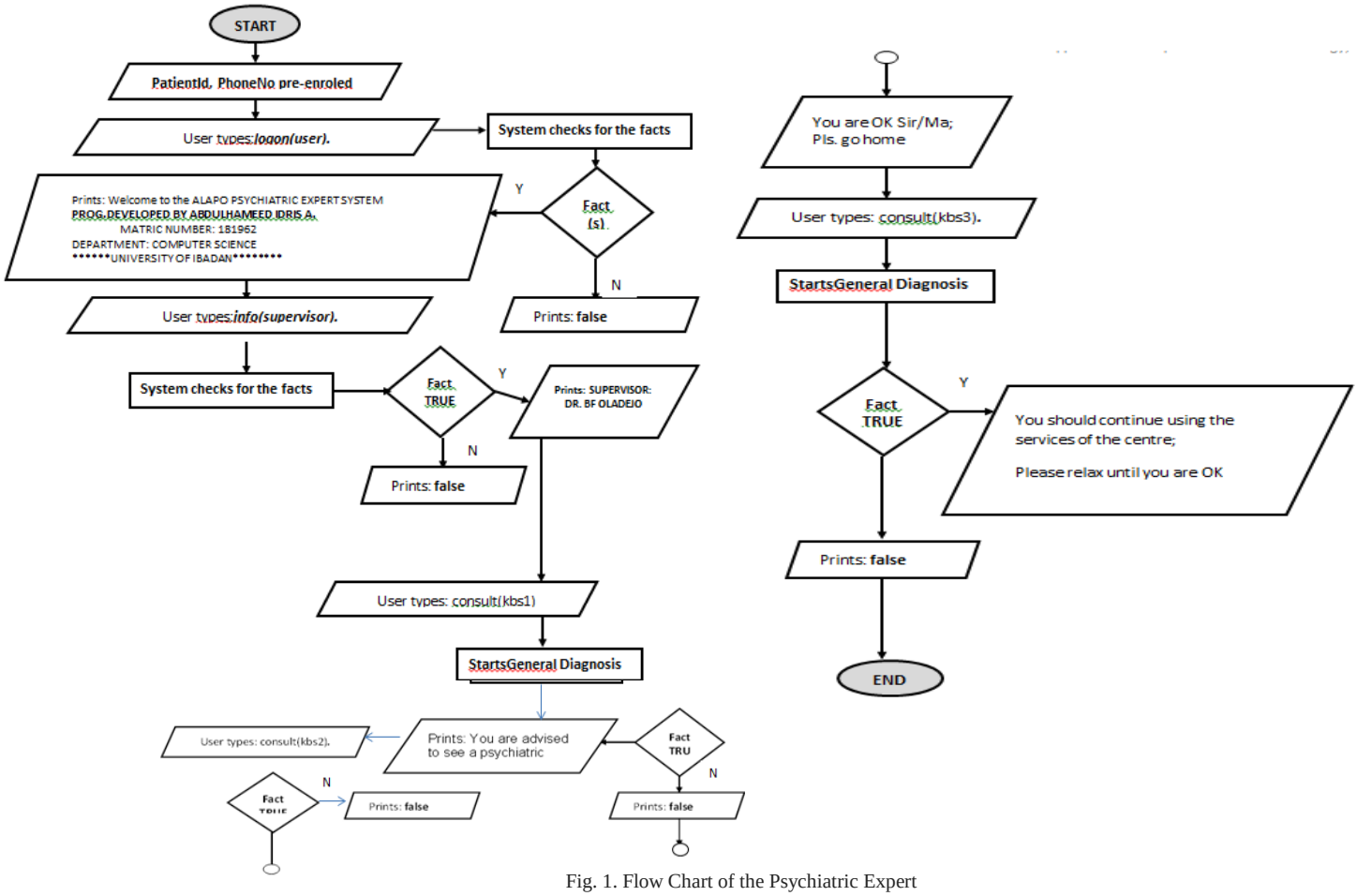

Fig. 1. Flow Chart of the Psychiatric Expert

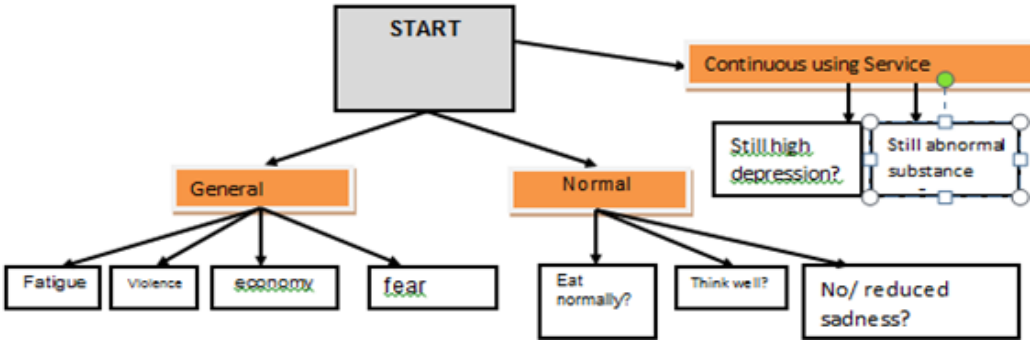

Fig. 2. Psychiatric Diagnostic Expert System

F) How does it Work?

The system makes uses forward and backward. It can be deduced that it will result into a depth-first search tree, where the rule node is the goal and the children nodes are rules for which the consequent form of the goal. For example once it checks the fact 1, if it doesn't find the result, it expands the node with a depth first search, discarding the sibling nodes. Therefore it goes further to check if the operation is in the remaining facts. When a node in the tree has an antecedent that has nothing else that implies it, meaning if the node takes the form of a rule whose antecedent cannot be inferred because no other rule in the system has that clause as a consequent, that node will become a leaf in the tree. Once a leaf is the goal, the diagnosis ends and there is a result. The Depth-first search goes top to bottom, and then it goes left to right, giving the highest priority to the leftmost child nodes. The system arranges child nodes from left to right, when a rule has antecedent that is present in multiple other rules as a consequent, the mechanism search for the rules within

From Fig. 2, the symptoms of psychiatric diseases are listed – fatigue, depression, not eating normally and so on. Also, referring to Fig. 1, we see the procedures it takes to use the proposed expert system.

V. RESULTS

The knowledge base contains all the facts and rules as applicable to the topic of discourse. The rules have antecedent and a consequent. When the user opens the CLI, he types ***loogon(user)***, the phrase is shown at the interface – "WELCOME TO THE ALAPO psychiatric expert system". If the rule and facts associated with logon (user) does not exist, it would flag "false". The engine fires the rule(s) by referencing the knowledge base. The testing stage involved using the already-entered facts and rules in the knowledge base, most of the patient's characteristics have been captured – patientId, symptom, phoneNo, status. The status means the recommended action – "SeeYourDoctor", "evaluation and treatment" and "goHome" as applicable. Querying a fact will flag a logical "true or false" (refer to Table I above).

VI. CONCLUSION AND FUTURE WORKS

In designing and implementing PES, we have learned the importance of knowledge representation and how to choose an appropriate knowledge representation for a particular domain. Majorly, we learned that the diagnosis of psychiatric illness requires fine-grained tests and evaluations to properly deal with specific circumstances. More so, we also learned that frames are too ambiguous of a representation to properly catch what should be simple diagnoses and actions. That is, the *IF X THEN Y* ontology is the most direct way to represent the problem domain. PES does not cater for symptoms like degree one mental problem for adults. For example, women with diabetes often have atypical symptoms of angina.

It is recommended that symptoms like grade one mental problem should be considered. Also, developers should consider all cases of psychiatry irrespective of differences in gender and age. Acute psychiatric ailments or extensive clinical physical/neurological disorders should also be considered in future study.

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