

Impact of excessive mobile phone usage prediction system using fuzzy logic

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Abstract : Fuzzy logic used to design a complex system more efficiently with simple way. It will give a clear solution. This paper aims to give an idea about controlling/predicting disease using fuzzy logic control. This paper describes the process that can be used to predict normal diseases like headache, eye-straining, exhaustion, body ache, anxiety, lack of concentration and normal (no disease) based on mobile usage time for different purposes like calling, gaming, music & video, social media, and total time.

Index Terms - Fuzzy logic, mobile usage, disease;

I. INTRODUCTION

Nowadays usage of mobile has been increased gradually and because of that different types of disease occurs on a regular basis. Most of the people spent so many hours on mobile phones for different purposes like calling, playing games, listening to music, watching video games, social media etc. Over usage of mobile phones, people are suffering from different diseases like headache, eye-straining, exhaustion, body ache, anxiety, lack of concentration etc. which are a common disease but it can lead to more severe disease like cancer and heart attack in future. So, we have introduced a fuzzy system which can predict the disease based on the time you spent on your mobile phones.

In Section II, different fuzzy terminologies have been discussed.

In Section III, the existing work related to disease and fuzzy system along with mobile usage time has been discussed.

In section IV, medical terms regarding this paper are explained

In section V, the workflow of our fuzzy system has been discussed. In the proposed fuzzy system total of 5 inputs have been taken and a total of 8 outputs have been produced. Different rules are defined based on input and from that rules, different outputs have been generated which is shown in Table 3.

In section VI, a result of the conducted experiment has been discussed.

II. FUZZY TERMINOLOGIES

Fuzzy Logic: L.A.Zadeh introduced fuzzy Logic in 1965. It is a rule-based inference. Non-linear problems can be easily solved with the help of fuzzy logic controller by using human knowledge into a controller [10]. People without a mathematical background can also understand easily. Fuzzy logic computing on "degree of truth". Boolean logic will give crisp output while fuzzy logic will give output with some degree of membership. [10]

A. Fuzzy set:

It is a collection of ordered pair.

$F = \{s, \mu(s) \mid s \in X\}$, $\mu(s)$ is a degree of s . If a member is present in fuzzy set then there must be a degree of membership. [11]

Crispy set:

It is a collection of elements.

$S = \{s \mid s \in X\}$, there is a strict boundary either yes or no. [11]

B. Fuzzy Operations:

Different fuzzy operations can be performed on different fuzzy sets. [11]

Operation Name:	Equation/description
Inclusion:	$S(x) \leq Y(x) \rightarrow$ One set is part of another set.
Equality:	$S(x) = Y(x) \rightarrow$ one set is equal to another set
Complement:	$S(x) = 1 - S(x)$
Union:	$(S \cup Y)(x) = \max(S(x), Y(x))$
Intersection:	$(S \cap Y)(x) = \min(S(x), Y(x))$
Difference:	$(S - Y)(x) = \min[S(x), 1 - Y(x)]$

Table:1 Different fuzzy operations

C. Fuzzy Membership Function :It is used to characterize fuzziness using graphical format.
3 features are there for membership function.

Feature name	Notation	Description
Core	$\mu_A(y)=1$	It is the universe's region which is specified by full membership in a set
Support	$\mu_A(y)>0$	It is the universe's region which is specified by non zero membership in a set
Boundary	$1>\mu_A(y)>0$	It is the universe's region which is specified by non zero but incomplete membership in a set

Table:2 Fuzzy membership function's feature

Three common fuzzy membership functions are:

- 1) **Triangular Mfs**: To draw a triangular shape three parameters are required
a lower limit (a)
an upper limit (b)
and a value (m), where $b > m > a$. [12]

$$\mu_A(x) = \begin{cases} 0, & x \leq a \\ \frac{x-a}{m-a}, & a < x \leq m \\ \frac{b-x}{b-m}, & m < x < b \\ 0, & x \geq b \end{cases}$$

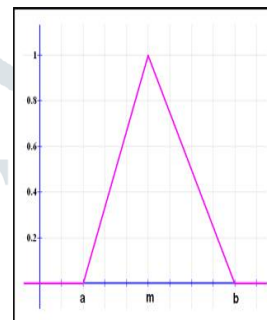


Fig: 1(a)

- 2) **Trapezoidal Mfs**: To draw a trapezoidal shape four parameters are required
i) a lower limit (a)
ii) an upper limit (d)
iii) a lower support limit (b),
iv) an upper support limit (c), where $d > c > b > a$. [12]

$$\mu_A(x) = \begin{cases} 0, & (x < a) \text{ or } (x > d) \\ \frac{x-a}{b-a}, & a \leq x \leq b \\ 1, & b \leq x \leq c \\ \frac{d-x}{d-c}, & c \leq x \leq d \end{cases}$$

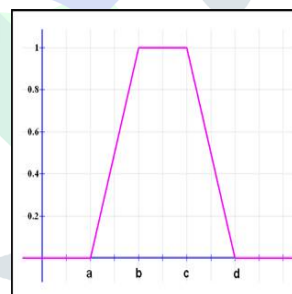


Fig: 1(b)

- 3) **Gaussian function**: To draw a bell-shaped curve two parameters are required.
i) a central value (m)
ii) a standard deviation (k) > 0 . The smaller k is, the narrower the "bell" is. [12]

$$\mu_A(x) = e^{-\frac{(x-m)^2}{2k^2}}$$

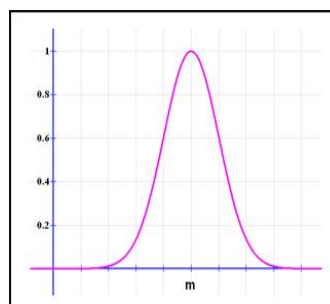


Fig: 1(c)

D. How to write fuzzy rules.

Collection of statements which describe how fuzzy inference system (FIS) should make a decision concerning classifying an input or controlling output is known as a fuzzy rule. [10]

Fuzzy rules are written in the following form:

If (input 1 = membership function 1) and/or (input 2 = membership function 2) and/or (input n = membership function n) then (output n = output membership function n)

For example

if $a=b$ and $b=c$ then $a=c$.

III. EXISTING WORK

Numerous medical diagnosis systems have already been developed based on the fuzzy set model and have already been applied in treatments and diagnosis.

V. Prasath et al. supply several applications of fuzzy logic in medical decision support. Based on that, future work of fuzzy control and observe technologies in medicine and healthcare can be estimate. Fuzzy logic provides a means for encapsulating the subjective decision-making process in an algorithm suitable for computer implementation. As such, it materializes to be eminently suited to aspects of medical decision making. The concepts behind fuzzy logic are uncomplicated. That is Proportionately easy to performance in software. [1]

Aman Jatain et al. proposed a system for medical diagnosis which is a generated using Fuzzy Logic Toolbox in MATLAB. It was focused by medical diagnosis. Medical diagnosis research will to help a human, in this case, patients performing discussion for self-analysis. This system will behave like an expert in this case, like accomplish interviews with the sufferer. It gives easier ways to decrease the doctor's load. The medical interpreter and patients were given many advantages. [2]

Cott S. Lancaster et al. consider a medical device whose design was based on Fuzzy logic control (FLC). FLC engage for guide the regulator which engage air stress to your skin of human consisting of the analog-to-digital converter for data assembly, pneumatic valve and alarm was used to manage air stress.[3]

Ch.Schuh et al. described how human health care systems can use Fuzzy logic [4].

Christian J. Schuh et al. organize a fuzzy logic, fuzzy sets, and relations-based survey. And how fuzzy control and their application in medical science can use Fuzzy logic. The research paper describe GlucoNotify single glucose data setting, fuzzy automata notion for ARDS treatments. [5]

Supriya Kumar De, Ranjit Biswas and Akhil Ranjan Roy et al. proposed the research on using intuitionist fuzzy logic principle. This extends the study of some individuals and the result was given in tabular form. Patients faced problems which solve using new technique in our modern time. [6].

O.E. Matiluko et al. made a medical diagnostic system using fuzzy logic; so as for enhancing the accuracy and preciseness of medical diagnostics. The proposed medical diagnostic system has been developed with help of Visual Prolog Programming language. This system proofer's solution to enormous responsibilities of diagnostic process done by medical personnel using fuzzy logic. Advanced medical system can be designed to help in negative grounds like drugs prescription, registering of patients as well as keeping their records and personal details. [7]

According to A.E.S Ahmed et al. "In medical sector many Decision Support System (DSSs) are designed, such as Aaphelp, Internist, Mycin, Emycin, Casnet/Glaucoma, Pip, Dxplain, Quice medical reference, Isabel, Refiner series system and PMA. Which helps medical practitioner in their choice of decisions for diagnosis and treatment of different diseases. [8]

According to an article by Zadeh LA "automated system based on fuzzy logic has a wide use in control systems, household appliances, and decision making systems, automated and medical industries. Terminologies used in fuzzy logic are not limited to fuzzification, defuzzification, rules, domain, member function, linguistic variables etc". [9]

IV. MEDICAL TERMS

Overuse of mobile phones can develop so many different problems that may difficult to cure or even lead to fatality, including:

Headache

A pain located in the head, as over the eyes, at the temples, or at the base of the skull. Headache like chest pain or backache has many causes. Migraine is a kind of headache which is follow by beating and pulsating pains. This sort of headache would be start by indecipherable pains which could be transformed to knocking and beating pains. [13]

Eyes straining

Eye strain, also known as asthenopia is an eye condition that manifests through nonspecific symptoms such as fatigue, pain in or around the eyes, blurred vision, headache, and occasional double vision.

Its a symptom, not a disease. It occurs when eyes gets tired from intense use over a long period of time. Any eye discomfort caused by looking at something for a long time, can be termed as eye strain. [14]

Lack of concentration

Times are there when we simply can't focus our mind at work. We have our mind hovering to another topics or simply because we're not interested. Difficulty concentrating is a normal and periodic occurrence for most people. Tiredness and emotional stress can cause concentration problems in most people. [15]

Anxiety

Anxiety is a state of apprehension and psychic tension occurring in some forms of mental disorder. Foreboding is feeling of overwhelming apprehension, stress, or fear. It builds up slowly in some people. It can vary too much and symptoms may also differ from person to person. It may worse when facing a stressful event. That's because many symptoms of anxiety happen to individuals and they can change it over time. [15]

Exhaustion

Exhaustion is the weariness of a being. Emotionally worn-out and drained as a result of accumulated stress from outside factors. Emotional exhaustion is a one of signs of burnout.[16]

V. EXPECTED SYSTEM

The Mobile Usage System consists of two inputs:

Mobile Usages (i.e.: Calling, Music and Video, Game, Social Media, Total Time etc.)

Time Duration.

The Mobile usage system is designed using 67 Rules. The Rules designed in this research are derived from a consult with doctor. Here we have used triangular membership function for all inputs and outputs for our system.

The Member function graph represent the X-axis is the input values which are obtained from mobile usage and it ranges from 0 to 24hours and the Y-axis is represent the degree of the membership function. The mobile usage system consists of 5 inputs and 7 outputs which can be shown in Fig-1. Rules which is used in this system is listed in the table.

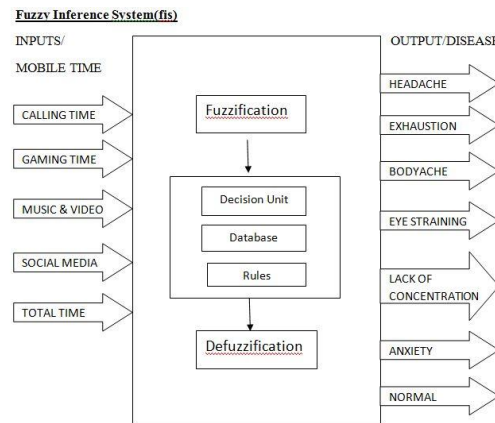


Fig 1: FLC for Mobile Usages

Fuzzification:

The fuzzy logic controller of Mobile usage system consists of 3 blocks such as fuzzification, fuzzy rule and defuzzification. The membership function is used for converting crisp input value to non-crisp input value then after to applied the related operation on the non-crisp input value. It's called fuzzification and fuzzification is performing using fuzzifier. The fuzzy logic controller are made the rules and this rules is known as fuzzy rules. Based on this rules fuzzy logic controller made the decision. The fuzzy rules are common English statements like sets of "IF" and "THEN" statement. In this research we are derived the rules from a consult with the doctor. The table show set of rules which are used in this paper.

Rules:-

Rule number	Mobile usages	Time duration	disease name
1	Call_Normal	0 to 4hr	Headache
2	Call_Low	4hr to 8hr	Headache
3	Call_Low_Medium	8hr to 12hr	Headache
4	Call_Medium_Medium	12hr to 16hr	Exhaustion
5	Call_High_Medium	16hr to 20hr	Exhaustion
6	Call_High	20hr to 24hr	Bodyache
7	Call_High	20hr to 24hr	Headache
8	Game_Normal	0 to 4hr	Eye-straining
9	Game_Low	4hr to 8hr	Headache
10	Game_Low_Medium	8hr to 12hr	Headache
11	Game_Low_Medium	8hr to 12hr	Exhaustion
12	Game_Medium_Medium	12hr to 16hr	Headache
13	Game_Medium_Medium	12hr to 16hr	Exhaustion
14	Game_Medium_Medium	12hr to 16hr	Lack of concertation
15	Game_High_Medium	16hr to 20hr	Headache
16	Game_High_Medium	16hr to 20hr	Exhaustion
17	Game_High_Medium	16hr to 20hr	Lack of concertation
18	Game_High_Medium	16hr to 20hr	Eye-straining
19	Game_High	20hr to 24hr	Headache
20	Game_High	20hr to 24hr	Exhaustion
21	Game_High	20hr to 24hr	Lack of concertation
22	Game_High	20hr to 24hr	Eye-straining
23	Game_High	20hr to 24hr	Bodyache
24	Music&Video_Normal	0 to 4hr	Normal
25	Music&Video_Low	4hr to 8hr	Headache
26	Music&Video_Low_Medium	8hr to 12hr	Headache
27	Music&Video_Medium_Medium	12hr to 16hr	Headache
28	Music&Video_Medium_Medium	12hr to 16hr	Lack of concertation
29	Music&Video_High_Medium	16hr to 20hr	Headache
30	Music&Video_High_Medium	16hr to 20hr	Lack of concertation
31	Music&Video_High_Medium	16hr to 20hr	Anxiety
32	Music&Video_High	20hr to 24hr	Headache
33	Music&Video_High	20hr to 24hr	Lack of concertation
34	Music&Video_High	20hr to 24hr	Anxiety

35	Music&Video _High	20hr to 24hr	Bodyache
36	Social_Media_Normal	0 to 4hr	Normal
37	Social_Media_Low	4hr to 8hr	Headache
38	Social_Media_Low_Medium	8hr to 12hr	Headache
39	Social_Media_Low_Medium	8hr to 12hr	Exhaustion
40	Social_Media_Medium_Medium	12hr to 16hr	Headache
41	Social_Media_Medium_Medium	12hr to 16hr	Exhaustion
42	Social_Media_Medium_Medium	12hr to 16hr	Anxiety
43	Social_Media_High_Medium	16hr to 20hr	Headache
44	Social_Media_High_Medium	16hr to 20hr	Exhaustion
45	Social_Media_High_Medium	16hr to 20hr	Anxiety
46	Social_Media_High_Medium	16hr to 20hr	Lack of concertation
47	Social_Media_High	20hr to 24hr	Headache
48	Social_Media_High	20hr to 24hr	Exhaustion
49	Social_Media_High	20hr to 24hr	Anxiety
50	Social_Media_High	20hr to 24hr	Lack of concertation
51	Social_Media_High	20hr to 24hr	Bodyache
52	Total_Time_Normal	0 to 4hr	Normal
53	Total_Time_Low	4hr to 8hr	Headache
54	Total_Time_Low_Medium	8hr to 12hr	Headache
55	Total_Time_Low_Medium	8hr to 12hr	Exhaustion
56	Total_Time_Medium_Medium	12hr to 16hr	Headache
57	Total_Time_Medium_Medium	12hr to 16hr	Exhaustion
58	Total_Time_Medium_Medium	12hr to 16hr	Anxiety
59	Total_Time_High_Medium	16hr to 20hr	Headache
60	Total_Time_High_Medium	16hr to 20hr	Exhaustion
61	Total_Time_High_Medium	16hr to 20hr	Anxiety
62	Total time _High_medium	16hr to 20hr	Lack of concertation
63	Total time_high	20hr to 24hr	Headache
64	Total time_high	20hr to 24hr	Exhaustion
65	Total time_high	20hr to 24hr	Anxiety
66	Total time_high	20hr to 24hr	Lack of concertation
67	Total time_high	20hr to 24hr	Bodyache

Table 3: Set of Rules for Fuzzy Mobile Usage System

The rules derived in Table can be read in terms of IF and THEN statements as shown below.

Rule 1:

IF (Type of mobile usage is call_normal) and (Time duration is 0 to 4hr) THEN (disease is Headache)

Rule 9:

IF (Type of mobile usage is Game_normal) and (Time duration is 0 to 4hr) THEN
(disease is Eye Straining)

Rule67:

IF(Type of mobile usage is Total time_high) and (Time duration is 20 to 24hr) THEN (disease is Bodyache)

The rules are defined in team of imprecise sense and they all are not crisp but fuzzy values see in fig 3. At end the crisp value of the disease is obtained as an answer.

In this system, we have applied a total of 5 inputs and based on that we have derived 7 normal diseases which are shown in Fig-1. The resultant output and rule declaration shown in figure 3(a),3(b),3(c),3(d).

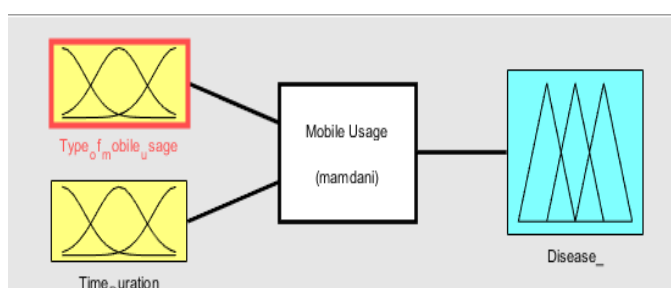


Fig 3(a): Mobile Usage System usage

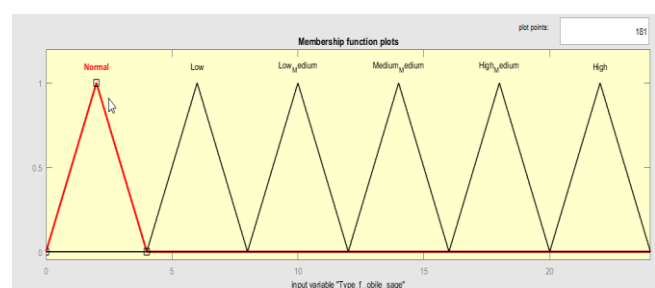


Fig 3(b): A membership Function for input variable usage

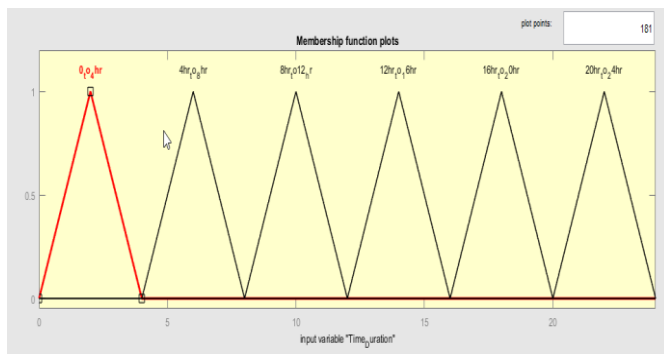


Fig 3(c):A membership function for input variable Time duration

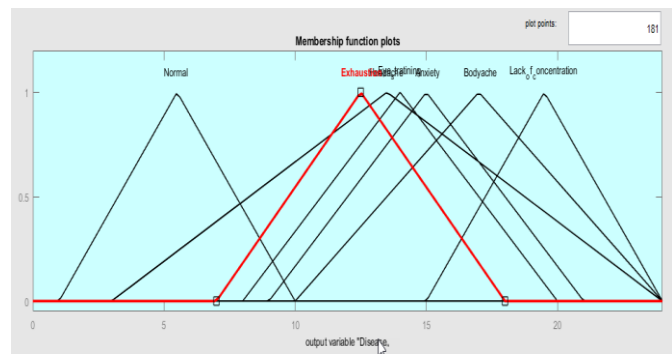


Fig-3(d) A membership function for Output variable Disease.

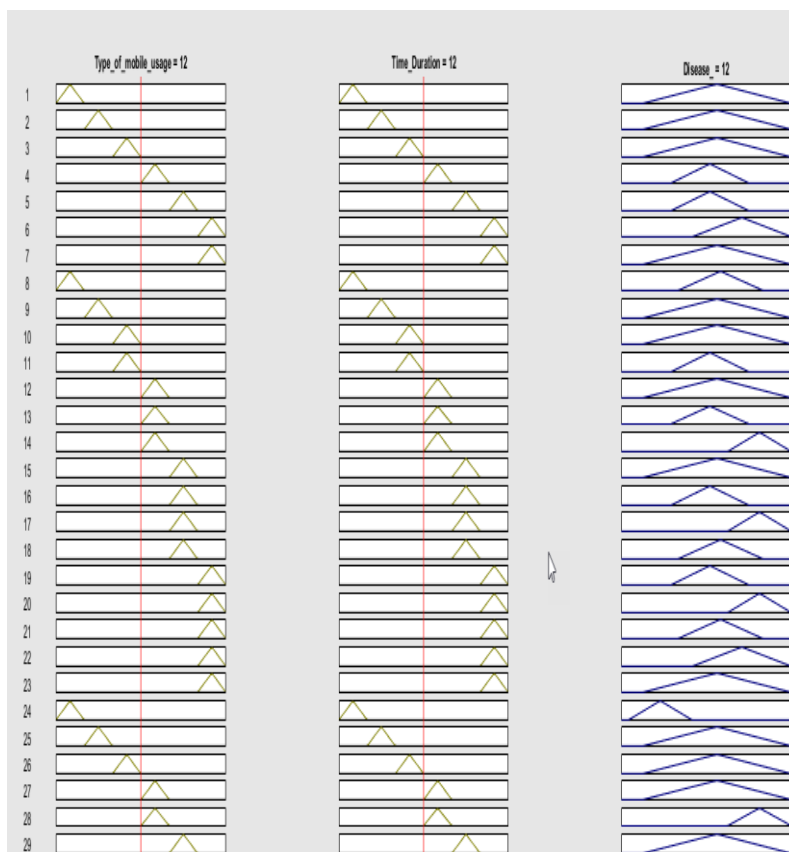


Fig 4: Rules for Mobile Usage System

Defuzzification:

The fuzzy inference system made the result than after to produce a quantifiable result i.e

People spent more time on mobile usage than suffering from different diseases(Disease name). The defuzzification is used for converting non crisp values to crisp values.

Results and Discussion:

Using of fuzzy logic control, we made different normal disease by giving mobile time usage and time duration as an input and the output value for the disease is obtained. Figure 5. shows the response surface of the input-output relations as determined by the fuzzy interface unit.

This is the fundamental unit in which the application interface FIDE encodes controller information.

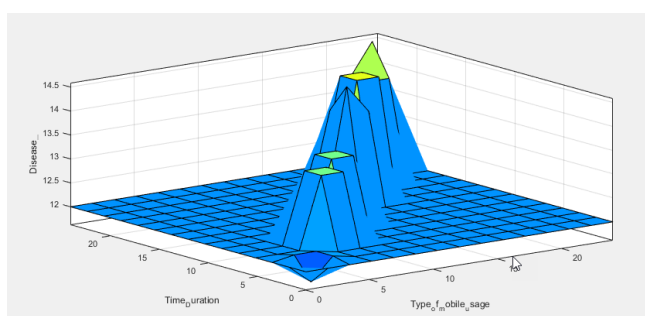


Fig 5(a):Response surface of input-output relations

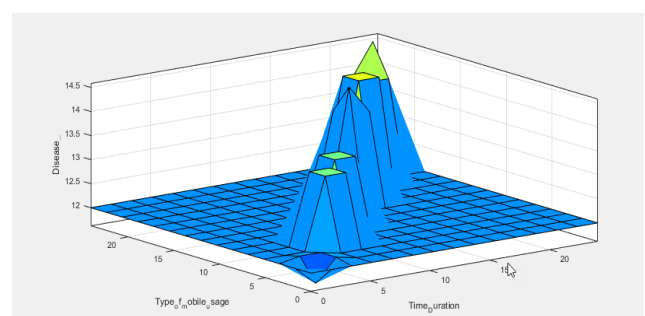


Fig 5(b): Response surface of input-output relations

The result in the above plot shows how disease can be predict based on mobile time usage and time duration.

VI. CONCLUSION

With the increasing usage of mobile, it will directly affect to human health. So, in this paper we have tried to apply fuzzy logic in mobile system usage to predict disease based on how many hours you are spending in mobile, mobile related diseases can be predicted with the help of fuzzy logic. In this paper we have considered only common disease but as a future enhancement specific disease like cancer, tumor etc. can be predict with the help of fuzzy logic.

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