Industrial Engineering Letters
ISSN 2224-6096 (Paper) ISSN 2225-0581 (online)
Vol.3, No.12, 2013

Determination of Time of Death Predictive Model

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ABSTRACT

This paper focuses on model development for predicts the time of death occurring at given time.

The mathematical model is based on newton's law of warming and cooling

For the effective utilization, the model was later stimulated with MATLAB program and this enable us to predict the time of occurrence.

With this visualization approach, innocent person can be easily exonerated from a particular crime because the time at which particular death occurred can easily notice and determine

Keyword and Phrase:- Time of death, model Algor mortris, post morterm interval stimulation, etc

INTRODUCTION

Time of death according to (Jay Dix and Michael Graham, 1999) is not easy to established until it is witnessed with person. Establishment of the time of death and when the body is found (post mortem interval) involved a lot of observations.

Observed condition (according to Jay Dix and Micheal Graham , 1999) involving the body in change rigor mortis, liver mortis, algor mortis, and stomach contents may be used to determine the time of death.

It is better to discuss the above mentioned observation as follow:

Rigor Mortis:- according to (Tay Dick and Micheal Ghraham, 1999), Rigor Mortis involved the muscle of the body initially become flaccid immediately after the death. Within 1 – 3 hours following the deaths, muscles begin to a proles know as rigor mortis (post mortem) and joint immobile (freeze). The rigor mortis involved the formation of locking chemical bridges between the muscle protein actin and muosin and does not involve muscular shortening, while physiological muscular contraction involves shortening of muscle as the actin molecules reversibly in that position until rigor passes or it is physically over come such as when a join is forcibly involved.

All, muscles of the body begin to stiffen at the science time other the death.

However, the stiffening becomes noticeable in the small of muscle groups before the large groups, given the appear and that Niger mortis proceeds at different rates in the various muscle groups. This is one of the observation that can be used to determine the time of death.

Liver Mortis: According to (Jay Disk and Michael Graham, 1999) is the discolourng of the body after death due to the gravitational setting of blood which is no longer being pumped through the body by the beint

Liver mortis is usually noticeable approximately one hour after the death and is often apparent earlier, within twenty to thirty minute. The discolouration increases in intensity and usually be one's filed in about 8 – 10 hours.

The formation of liver mortis may be prevented or hundred by apply pressure

Algor Mortis :- according to (Tay Dick and Micheal Grahams, 1999) described algor mortis as the body equilitrates with the surrounding environmental temperature

Flow ever, measuring body or body temperature may be used in predict post mortein interval of the death's body.

Gastric contents:- Tay Dick and Micheal Grahams, 1999) described Gastric contents is total volume and a description of food, liquid or other material present in the stomach should be recorded at autopsy. This intermention is helpful not only for.

This is not the First time a reasonable work will be carry out on the determintion of time of death especially with the use of mathematical model.

Single Exponential Model Based on Newton's "Law of Cooling" first published in 1701 as a paper entitled "Scala Graduum Caloris" that appeared in the Philosophical Transactions of the Royal Society of London.
While testing the cooling of a red hot iron bar Newton concluded: "The excess of degrees of heat [temperatures] of the iron were inThe excess of degrees of heat [temperatures] of the iron ... were in geometrical progression, when the times were in arithmetical progression."
Stating this in more modern language: The rate of cooling is linear in the difference between the temperature of the heated object and the surrounding (ambient) temperatureof the heated object and the surrounding (ambient) temperature.

Rainy,(1868), also applied this rule to the cooling of deceased bodies in an article in the Glasgow Medical Journal entitled "On the cooling of Dead Bodies as Indicating of the Length of Time Since Death." Rainy's approach was the first method for estimating time since death that took into account a scientific principle for estimating thedeath that took into account a scientific principle for estimating the manner in which bodies cool.

In Marshall, (an M.D.), and Hoare (a Physicist), (1962), "Estimating the time of death. The rectal cooling after death and its mathematical expression." and two follow up papers in the Journal of Forensic Science that explored the phenomena and developed a model for the sigmoidal shaped curve.

The aim of this paper is to be able to determine exact time particular death occurred. This will enable us also to determine the exact person or group of people who carried out the crime activities if the need be to know the offender and Isolate those that are not involved.

This model will surely help law enforcement agencies especially the police force and judiciary in carry of their investigations.

Problem Formulation

The problems that deal with time of death need physical or concrete example a in order to be able to a assist law enforcement agencies in carry out their duties and some common example are given below.

Material and Method

In this paper, we shall use the data collected when the death occur. Especially, the temperature of the body when the death occurred, the room temperature and the temperature of the body when investigator arrived. The method shall base on the modeling that develop with firth order differential equation given as.

Assumption :-

1. The temperature of dead body is radiating
2. Loss in temperature is taken place
3. Two conditions were imposed on different equations.

$\frac{dT}{dt} \propto (T - Tm)$ ……. Eq 1

$\frac{dT}{dt} = k\,(T - Tm)$ ……..Eq 2

$\frac{dT}{(T-Tm)} = Kdt$

Integrate both sides to get

In (T- Tm) = Kt + C …….. Eq 3

Take log of both sides

$T - Tm = e^{kt}\ e^{c}$

Let $e^{c} = A$

$T = Tm + A\,e^{kt}$ ……..Eq 4

$T(t) = Tm + A^{kt}$…… Eq5

Where:

T(t) is the initial temperature of the dead body,

Tm is room temperature at time (t),

A is the constant of integration and

K is the exponential constant

Base on the model develop above in equation 5, the manual solution to determine the time of death for the can be giving below in manual solution as case 1.

Case 1:-

A Police personnel discovered the body of dead person presumably numbered by a gum shoe and the problem is to estimate the time of death. The body is located along the road kept at a constant 85^{0}F, for some time after the death, the body will radiate heat into the cooler room causing the body's temperature to decrease assuming that the victim's temperature was normal 110^{0}F at the time of death. The expert will try to estimate this time from body's current temperature and calculating how long it will have to lose heat to reach this point.

Manual Solution:-

$\frac{dT}{dT} = K(T- Tm)$

integrate both side to get Equation below

$\ln (T - Tm) = kt + C_1$

$T - Tm = e^{(kt + a)}$

$= e^{kt} - e^{a}$

$= Ae^{kt}$

$T = A e^{kt} + Tm$

$T = Tm + Ae^{kt}$

We have

$Tm = 85^0$ then

$T = 85^0 + A e^{kt}$

First time :- The official arrival at 1:32 pm

The body temperature was $103\text{-}2^0$F.

i.e $Tm = 103.2$ $t=0$

$T(t) = 85 + Ae^{kt}$

$103.2 = 85 + A e^{kto}$

$18.2 = A$

$A = \underline{18.2}$

The model becomes,

$T(t) = 85 + 18.2 e^{kt}$

45 min after (2:17pm). The temperature of the body was 91.7^0F.

i.e

$t = 45\text{min}$ $T = 91.7^0$F

$91.7^0 = 85+18.2e^{k \times 45}$

$6.7 = 18.2 e^{45k}$

$\frac{6.7}{18.2} = e^{45k}$

$e^{45k} = 0.3681$

Adding in to both sides

$45k = \text{in } (0.3681).$

$45k = - 0.9994$

K = -09994/45

= -0.0222

Hence, the model becomes.

$T(t) = 85+18.2\ e^{-0.0222t}$

Prediction:- when the normal temperature of the body is 110^0F

$T = 85 +18.2\ e^{-0.0222t}$

$110 = 85 + 18.2e^{-0.0222t}$

$25 = 18.2e^{-0.0222t}$

$e^{-0.0222t} = 25/18.2$

$e^{-0.0222t} = 1.3736$

Adding in to both sides.

$\text{In } e^{e-0.0222t} = \text{in } (1.3736)$

$-0.0222t = 0.3174$

$t = \frac{0.3174}{-0.0222}$

= -14.297

= -14 minute

i.e the death was happened 14 minutes before the police officer arrive

t =1.18pm

Computational Methods:

The computational method can also be used as an alternative to manual method. These will assist a lot in generating the accurate time when death occur. The output of the computational method written with MATLAB program version 7.0 which is one of the High Level Languages is given below as

Case 2:

enter the room temparature:70

Tm = 70

enter the body temparature when the police arive:90

T1 = 90

enter the second temparature Reading of the body:85

T2 = 85

enter the time interval for second reading of temperature:45

t2 = 45

-0.0064

enter the temperature of the body when death occure:110

T3 = 110

t3 = -108.4239

enter the time that the death occur in local time:12.30

t4 = 12.3000

the time the death occur

D = 629.5761

D1 = 10.4929

The time the death occur is:

10.4929AM

Discussion of the Results

The MATLAB program fashion 2007A which is one of high level languages was used for stimulations and visualization of time of death.

The manual and computer outputs of the model for determination of time of death were given above.

The two output were given in order to compare the adequate method for determination of time of death.

Conclusion and Recommendation

This research work has a lot of benefit based on the model that was developed especially in crime control and we can achieved the following:

1. Identification of particular person involved in crime can be easily identify
2. It can used to settle dispute especially when a lot of people are arrested at different time
3. It will assist the police and other law enforcement agencies in carrying out their normal duties
4. It is less costly and time accurate in identifying the offender, when method is used.
5. It can serves as alternative for medical identification.

We hereby recommended that this type of model especially when computerized should be used to investigate a particular crime, when the death occurred.

Further Research

These paper can also be developed further by not only locating the time the death occur but also identify the particular person involved by incorporating some further experiment such as finger print.

REFERENCE:-

1. Brain D.H and Daniel T.V (2007) Essential matlab for Engineers and scientists, published by else vie New York
2. Wa man S.J (2006): software Engineering, published by Tafa McGraw – Hill limited, New Delhi.
3. Jay Dix and Micheal Graham (1999) Time of death, Decomposition and identification an Atlas, Published by library of congress, New York. Microsoft Encanter, accessed 2007,
4. John, R,H and Atul (2006): programming with C++, published by Tafa Mc-Graw- Hill, company Limited, New Delhi.
5. Bruce, E.L et al (2009): Hydraulic of pipeline systems, Library of congress cataloging in publication data, New York.
6. Kreith, F.B et al (2008): "Fluid Mechanics", Publisher CRS Press U.S.A
7. Brian, D.H and Danel, T.V (2007): Essential MATLAB for Engineers and Scientists, 3rd edition, published by Elsevier New- York.
8. Marshall, T K, and Hoare, F E, "Estimating the Time of Death: the rectal cooling after death and its mathematical expression", Journal of Forensic Sciences, 1962, v 7, n 1, pp 56 8156 - 81

Acknowlegdements

We will like to use this opportunity to extend our sincere appreciation and gratitude to all our friends and students at all time. We thank Professor J.S. Sadiku of department of Ilorin, Ilorin Nigeria. In addition, professor M.O. Ibraheem Head of department of Mathematics University of Ilorin, Ilorin Nigeria.