A DEADLOCK SYSTEM FOR DRUNK DRIVER USING PULSE DETECTOR COMBINATION WITH THERMAL DETECTOR

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Thematic paper
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ABSTRACT

"A Deadlock system for drunk drivers using a pulse detector in combination with a thermal detector" is a passive car system with the objective of enabling the pulse or thermal detector as a tool tostop the engine and to control ignition systems starting and stopping.

The researcher has gathereddata by collecting information obtained from a population sample group of 107 aged between 18-55 years old. A Blood Alcohol Concentration (BAC) for calculating alcohol elimination technique was used for measuring alcohol in the human body. The data collection was basedon fourstandardized criteria. The Faculty of Physical Therapy, MahidolUnivesity, methodology was used to classify the alcohol level. The system used an infrared pulse detector to measurethe heartbeat.

The results show that the proposed system will be useful for applyingtocar ignition systems.

KEY WORDS: DEADLOCK SYSTEM/ INFRARED PULSE DETECTOR/ DRUNK DRIVER/ INTERLOCK SYSTEM

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ระบบหยุดการจุดระเบิดเครื่องยนต์เพื่อป้องกันผู้เมาสุราขับขี่พาหนะโดยวัดจากชีพจรและอุณหภูมิ
A DEADLOCK SYSTEM FOR DRUNK DRIVER USING PULSE DETECTOR COMBINATION WITH THERMAL DETECTOR

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บทคัดย่อ

งานวิจัยนี้เป็นการนำเสนอการออกแบบวงจรที่สามารถตรวจวัดอาการของผู้ดื่มสุรา เพื่อใช้ในการตัดสินใจอนุญาตให้ขับขี่ยานพาหนะ โดยออกแบบวงจรที่สามารถตรวจจับชีพจรของผู้ดื่มสุรา ที่ใช้เทคนิค Infrared Pulse Detector (IPD) ร่วมกับ การวัดอุณหภูมิและปริมาณแอลกอฮอล์ในเหงื่อ Transdermal alcohol sensing instrument เพื่อเพิ่มความแม่นยำ และประสิทธิภาพในการตรวจจับอาการเมาสุรา

ผู้วิจัยได้มีการเก็บรวบรวมข้อมูลโดยข้อมูลที่ได้จากตัวอย่างครอบคลุมอายุ 18-55 ปี จากการตรวจร่างกาย ความเข้มข้นของแอลกอฮอล์ในเลือด (BAC) ซึ่งมีการนำเทคนิคการคำนวณการกำจัดแอลกอฮอล์มาใช้ โดยองค์ความรู้จากในคณะกายภาพบำบัดมหาวิทยาลัยมหิดลถูกนำมาใช้ในการวิจัยครั้งนี้ ระบบนี้ใช้การตรวจจับชีพจรแบบอินฟราเรด ซึ่งข้อมูลที่ได้จากการวิจัยสามารถสร้างกฎได้ 4กฎ เป็นการรวบรวมระหว่างค่าอุณหภูมิและชีพจรเข้าด้วยกัน จึงทำให้ระบบมีความเที่ยงตรงและแม่นยำในการตัดสินใจในการ อนุญาตหรือไม่อนุญาตให้ผู้ขับขี่ ขับขี่ยานพาหนะ

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CHAPTER I
INTRODUCTION

Dead Lock Systems are the ethanol alcohol, thermal, sweat and heart rate detection that could prevent drunk driving if integrated into an ignition interlock system used for reduce the number of alcohol related traffic fatalities is to prevent people from drunk while driving.

1.1 Background and statement problems

Over 16,000 people were killed in alcohol related traffic crashes in 2005. This toll comprised 39% of all traffic fatalities in 2005 (NHTSA, 2006). Efforts to curb drunk driving have included an increase in the presence of law enforcement personal on the roads, stiff criminal and financial consequence if caught driving under the influence of alcohol and increase media coverage of the problem. These social solutions to the drunk driving problem have significantly reduced the percentage of alcohol related traffic fatalities.

Statistics of Road Traffic Accidents in Thailand during the Songkran new year and 7 days from the dangerous year from 2549 to 2555 found that injury and fatal accidents during this festival a lot. During the Songkran new year is over. This may be due to the New Year's season (High Season) with making the trip is the most popular.

The cause of the accident. The majority of alcohol or alcoholic beverages as possible. Although several public and private cooperation campaign "Drink Don’t Drive" to prevent accidents, but it is still the top of the accident. Despite a decline of 25.6 percent in 2552 to 19.8 percent in the year 2553 it is to be noted that high speed driver, overtaking driver, drive too close. Increased markedly. The driving behavior is affecting a total accident.

Office for National Statistics found that concern about drinking alcohol in the population aged 15 years and found that men who drink more than 50 percent,

despite the downward trend. But it still has a relatively high rate of alcohol use. As Thailand is one of the 10 women had a drink and have also increased alarmingly.

Working age group (aged 25-59 years) have a higher alcohol than other groups. Minor adolescents (aged 15-24 years) and elderly (age 60 years) who conduct the binge of Thailand, this is a major risk factor in causing the loss too many.

The best way to reduce the number of alcohol related traffic fatalities is to prevent people from driving drunk to being with. One aggressive method to eliminate drunk driving would be to fit every highway vehicle with ignition interlock (MADD, 2006). Current ignition interlock systems use a breath alcohol detector sample the driver's breath alcohol concentration prior to starting the car. If the detector senses a high enough concentration the ignition interlock system will act like a switch, preventing the engine from starting. Current breath testing interlock systems are cumbersome, expensive and carry the stigma of being a convicted 'drunk driving'. As a result, installation of ignition interlocks, as described previously, in every vehicle would most likely not be tolerated by the public.

The installation of ignition interlocks in every vehicle would be better accepted by the public if the detection was performed non-invasively. One method to accomplish this is to measure the driver's Blood Alcohol Concentration (BAC) by analyzing the ethanol consumed from their skin. It has been observed that 0.7% of the ethanol consumed is excreted through the breath, consisting what is measure by a breath alcohol detector. However, and additional 0.1% of the ethanol consumed is lost through sweat (Ramchandani, 2001), which can be detected at the surface of the skin. In additional to sweat, ethanol is also absorbed by the skin from the blood and transported to ethanol sensors into the steering wheel of a vehicle could allow an interlock system to continuously monitor the concentration of alcohol emitted from the drive's hands.

1.2 Objective

To study accuracy of infrared pulse detector can apply with transdermal sensing instrument in ignition car system.

1.3 Scope of study

1.3.1 To Study and collect pulse rate and thermal when drink alcohol.

1.3.2 To apply infrared pulse detector with transdermal detector.

1.4 Expect of results

1.4.1 Dead Lock System can help drunk driver to save their lives.

1.4.2 Dead Lock System can help to decrease the number of car accident.

CHAPTER II
LITERATURE REVIEW

This chapter has reviewed divide 9 Sections include.

1. Motivation
2. Calculate ethanol alcohol eliminate
3. Analysis of blood alcohol
4. Breathe alcohol test
5. Optical ratio metric sensor for alcohol measurement
6. Transdermal alcohol sensing instrument
7. Hand wave skin detector
8. Infrared pulse detector
9. Basic concept

2.1 Motivation

"Thailand Festival", a festival tradition, such as Thailand or Thai New Year Songkran Festival, Chinese New Year or Valentine's Day etc. These are the Festival of Happiness. Celebration and a time to go to meetings between the family / relatives or friends, especially in the holiday season with several consecutive days. However, in the celebration of the festival of happiness in these false beliefs. To socialize with alcohol or alcoholic beverages. This is the main cause of the accident during the voyage that resulted in the loss of life and property. In particular, incidents of traffic accidents.

2.2 Calculate ethanol alcohol eliminate

The transport of alcohol from ingestion to excretion through the skin, models of ethanol metabolism and ethanol transport were developed and linked. The

ethanol metabolism model consists of three well mixed compartments: the liver, the body fluids, and the stomach compartment. The second model describes ethanol diffusion through the skin. The skin is modeled as a two layer system that is exposed to the concentration of alcohol in the blood on one side and atmospheric air on the other. Since only minute amounts of ethanol are actually lost through the skin, the complete model does not reduce the total ethanol mass by the mass of ethanol excreted through the skin.

The ethanol elimination in the liver using classical Michaelis - Menten kinetics for enzymatic reactions.

$$\text{Ethanol elimination rate} = \frac{V_{\max} C_{Liver}}{C_{Liver} + K_m} \quad (1)$$

V_{max} represents the maximum rate the liver can metabolize ethanol given in mol/min, K_m is the concentration of ethanol necessary for the liver to metabolize ethanol at half of its maximum elimination rate, given in mol/liter and C_{Liver} is the concentration of ethanol in the liver, also given in mol/liter. The rate of ethanol elimination is proportional to the concentration of ethanol in the liver, so that ethanol is eliminated faster when higher concentrations are present, but reaches its maximum elimination rate of V_{max} when C_{Liver} overwhelms K_m.

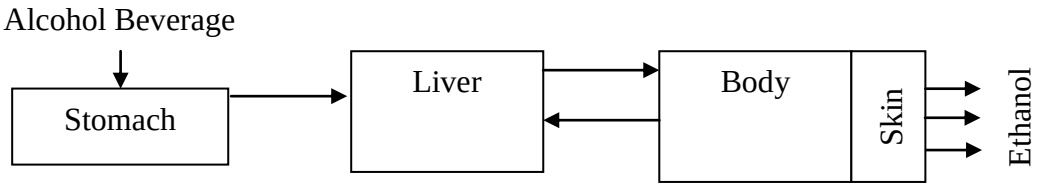

Figure 2.1 Model Diagram

The stomach compartment was added to the model to gradually add ethanol to the body, mimicking the actual behavior of the stomach. This is representative of how alcoholic beverages are absorbed into the blood stream. Figure 1 shows that the stomach compartment empties into the liver simulating the transport of ethanol from the stomach to the liver via the Portal vein which connects the small intestines to the liver. In this manner the liver may eliminate some of the ethanol

entering the system before it enters the body compartment. The rate at which the stomach empties is controlled by the constant k_s. Equation 2 describes the volumetric rate of change of the stomach contents as a function of k_s and the current fluid volume in the stomach.

$$\frac{dV_s}{dt} = -k_s V_s \quad (2)$$

Many values, developed both experimentally and computationally, have been suggested for k_s (Levitt, 1994, Wilkinson, 1977, Umulis, 2005). k_s was calculated based on k_{smax}, the maximum rate of emptying in min^{-1}, x, the dose of ethanol given in moles and a, a constant with units mol^{-2} as shown in Equation 3.

$$k_s = \frac{k_{s\max}}{(1 + a(x)^2)} \quad (3)$$

Using Equations 2 and 3 the rate of stomach emptying, and thus the rate of ethanol addition to the body, is controlled by the amount of ethanol in the stomach, in moles, and the volume of the stomach, in liters. The rate at which ethanol is added to the body is dependent largely upon the initial dose of ethanol in the stomach and the current volume of the stomach.

Mass balance equations were developed to describe the change in concentration between the liver compartment and the body compartment. Equation 4 describes the change in concentration of ethanol in the body compartment, where V_{Body} is the volume of the body fluids given in liters, and Q is the blood flow rate into and out of the liver, given in liters/min. It should be noted that V_{Body} represents both the blood volume and the volume of tissue fluids combined, which we took to be 60% of the total body mass. In this model both blood and water are considered to be well mixed since we are only concerned with the concentration of ethanol. Equation 5 describes the rate of concentration change in the liver. V_{Liver} is the volume of the liver, which we chose to be 0.61 liters. All concentrations are given in mol/min. The stomach emptying rate appears in the middle of this equation serving as the addition of ethanol to the liver compartment, multiplied by the concentration of ethanol in the stomach to give units of mol/min. Finally, ethanol is eliminated from the liver by the

last term, as described previously, at a rate proportional to the liver ethanol concentration.

$$V_{Body}\frac{dC_{Body}}{dt} = Q(C_{Liver} - C_{Body}) \quad (4)$$

$$V_{Liver}\frac{dC_{Liver}}{dt} = Q(C_{Body} - C_{Livver}) + (k_s V_{Stomach} C_{Stomach}) - \frac{V_{\max} C_{Liver}}{K_m + C_{Liver}} \quad (5)$$

Equations 2, 4 and 5 were solved using a stiff ordinary differential equation solver from the commercial computing package MATLAB.

SKIN MODEL – Several models exist to describe the transport of substances across the skin both from the skin's surface to the blood and vice versa (Anderson, 2006). Based on these models we modeled the skin as a two-layer system consisting of the epidermis and the stratum corneum, which have drastically different transport properties. A diagram is given in Figure 3. The concentration of ethanol in the blood, as calculated from the metabolism model, serves as the time dependent boundary condition imposed at the blood-epidermis boundary. Driven by the concentration gradient, ethanol diffuses through the epidermis and the stratum corneum to the atmospheric air boundary where a constant concentration devoid of ethanol is imposed.

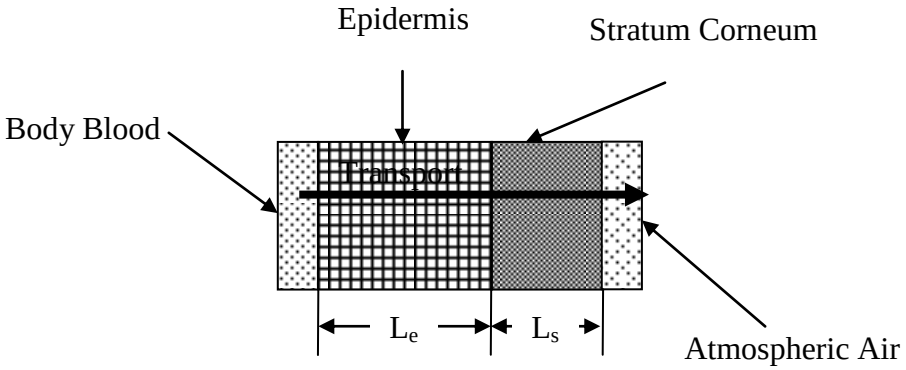

Figure 2.2 Skin Diagram

Equations 5 and 6 describe the transport of ethanol, in terms of partial pressures, across the epidermis and stratum corneum respectively. β represents ethanol solubility, D represents molecular diffusivity, A is the cross sectional area for transport

and L is the linear distance for this transport; all for the medium indicated by the subscript.

$$\beta_e A L_e \frac{\partial P_e}{\partial t} = D_e \beta_e A L_e \frac{\partial^2 P_e}{\partial x^2} \qquad 0 \le x < L_e \quad (6)$$

$$\beta_s A L_s \frac{\partial P_s}{\partial t} = D_s \beta_s A L_s \frac{\partial^2 P_s}{\partial x^2} \qquad L_e < x \le L_e + L_s \quad (7)$$

At x = 0, the partial pressure of ethanol in the blood is imposed at the epidermis. Similarly, at $x = L_e + L_s$ a partial pressure of zero is imposed which represents the clearing of the surface of the skin of ethanol vapor which would have accumulated there due to the diffusion process. A forward-difference approximation was implemented using MATLAB to solve Equations 6 and 7 simultaneously.

2.3 Analysis of blood alcohol

Static headspace analysis is routinely used in forensics laboratories for blood alcohol analysis and detection of abused inhalants. In recent years, many states have lowered the legal limits for blood alcohol levels. In the state of Ohio, for example, the maximum allowable ethanol level for an underage driver is 0.02%, while the maximum allowable level for an adult driver has been lowered from 0.10% to 0.08%. Additionally, the abuse of inhaled volatile compounds has increased significantly, necessitating the detection of common industrial solvents in blood. The abused inhalants are typically solvents found in household products such as enamel paints and glues. Like the blood alcohols, industrial solvents can be detected using static headspace analysis.

Since blood alcohol data must be valid in a court of law, use of flame ionization detectors require confirmatory evaluations on secondary gas chromatographic columns in order to ensure absolute component identification. Complimentary column phases have been introduced that provide rapid screening and confirmation data simultaneously from a single headspace injection.

For this application, static headspace analysis is used in conjunction with a dual-column/dual-FID gas chromatographic configuration to evaluate blood alcohols

at low levels (0.02%) and to detect volatile industrial solvents that may be present in blood samples.

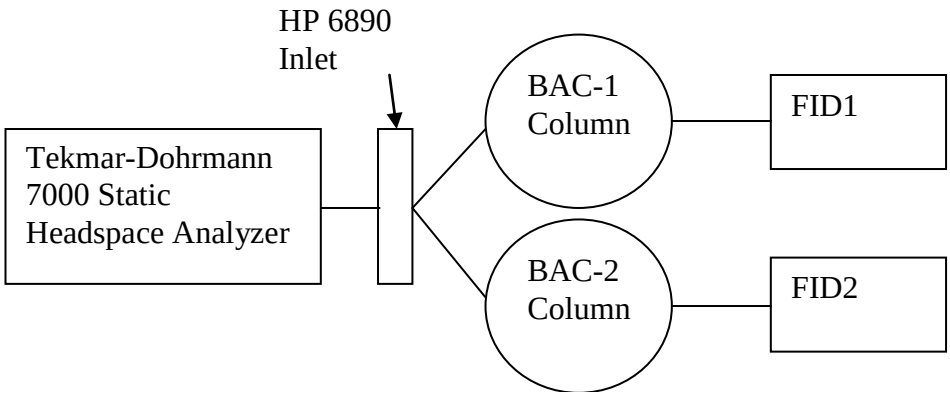

Figure 2.3 Tekmar-Dohemann diagram

Tekmar-Dohrmann 7000 headspace analyzer with dual FIDs and complimentary column phases. For both types of analysis the results yielded excellent reproducibility and linearity, making the system very versatile.

2.4 Breathe Alcohol Test

The Alcohol Breath Test (ABT), first initiated in the early 1950's, has presented a number of issues relative to scientific inquiry. Harger, Forney, & Barnes (1950) presented a device for sampling breath to determine blood alcohol concentration. Borkenstein and Smith (1961) applied the use of breath alcohol concentration testing to forensic purposes. Until the 1970's most ABT devices relied on the use of a galvanometer in the null balance photometric system to measure the color decrease in reagent (Lucas, 1986).

Beginning in the 1970's, infrared technology and analysis of alcohol in breath began to be applied in ABT instruments. With the additional application of the geometric expansion of computer technology, infrared ABT instruments have become the widely accepted ABT devices for policing agencies, courts, athletics, business and industry, and education (Inaba and Cohen, 2000).

One of the five current ABT infrared devices on the market is the BAC DataMaster. This instrument, as the other instruments, attempts to eliminate the effects

of mouth alcohol on the result of a breath alcohol test. In each case this is done through the use of a "slope detector" algorithm which is part of the computer programming incorporate to the instrument.

To assure mouth alcohol is not present when giving the ABT most regulations require a fifteen minute direct observation of the test subject to assure any mouth alcohol from consumption has been eliminated. The concern for elimination of mouth alcohol is based upon the theory that mouth alcohol can be measured as breath alcohol and therefore invalidates the breath alcohol test results.

The issue of mouth alcohol being present, and the need for elimination of this possible contaminant, has been addressed in numerous articles. Harding (1992) recommended a 15-20 minute observation period and that slope detection is not a substitute for the procedural countermeasures of direct observation and visual assurance that no foreign objects absorbing alcohol are in the mouth. In his research, Harding determined that in 2 out of 12 cases, denture adhesive would retain mouth alcohol for at least 20 minutes. Research by other investigators (Langille & Wigmore, 2000; Harding et al., 1992; Chu, Wells, King, Farrar & Drummon, 1998; and Logan & Distefano, 1998) have all supported the importance of direct observation and oral cavity examination for a period of 15 to 20 minutes in order to assure mouth alcohol is not present. These researchers also support the high importance of direct observation throughout the 15-20 minute period to assure a lack of belching or vomiting by the subject which would bring stomach contents containing alcohol into the mouth. A unique study by Veveland and Moreland (2001) has indicated mouth alcohol can be retained in the oral cavity for 30 minutes and under extreme conditions for more than 90 minutes. This study presents inferences for extensive follow-up research.

Consistent with the majority of studies cited, research has been conducted to produce mathematical models for elimination of mouth alcohol (Gullberg, 1992). Simultaneously, limited research has been undertaken to determine the adequacy and accuracy of ABT instruments regarding mouth alcohol. Research by Trafford and Makin (1995) yielded breath alcohol results in a subject significantly in excess of measured blood alcohol. These researchers, having completed a rigorous 15 minute observation period, attributed this difference to retained alcohol between dental bridges and gums in the subject's mouth. Additional research by Wilske, Eisenmenger,

& Liebhardt (1991) found 23 cases of breath alcohol results meaningfully above blood alcohol results. This was suggested to be a result of slope detectors in the instrument not detecting mouth alcohol and erroneously adding the mouth alcohol measure to the breath alcohol result. Gullberg (2000) found that for subjects already having measurable breath alcohol, biases can exist in those having mouth alcohol and remain undetected by the "mouth alcohol" (slope detector) algorithm in the BAC DataMaster instrument.

In explanation of this failure of the algorithm in the BAC DataMaster slope detector, Hlastala (1996) produced results indicating mouth alcohol will generate an erroneously high reading as the mouth alcohol will be picked up and added into the breath alcohol. He indicated this would occur on two occasions: 1) when the subject stops exhaling at approximately the point where the alcohol concentration reaches a maximum and 2) when small quantities of mouth alcohol are present.

It has been suggested that the BAC DataMaster will always present the result of "invalid sample" when mouth alcohol is present (National Patent Analytical System, 1997). As research has indicated, mouth alcohol can erroneously elevate breath alcohol concentration due to the ability to detect mouth alcohol in certain circumstances; training of this nature can be in error.

Based upon the existing research, the time limits possible for retention of mouth alcohol, the possibility of blood or stomach contents being brought into the mouth and the "slope detector" algorithms not adequately excluding mouth alcohol from results, there appears sufficient questions for further research. The purpose of this study was to determine if the BAC DataMaster would detect and report mouth alcohol as an "invalid sample" or as a numerical breath alcohol result, when mouth alcohol was present during the fifteen minute observation period.

METABOLISM MODEL VALIDATION – Validation of the model was performed using available experimental data published from several sources. Figure 4 presents the BAC predicted by the model overlaid with experimental data taken from Wilkinson [1977] under the same experimental conditions. Simulations were conducted for 95% ethanol doses of 15, 30, 45 and 60 ml diluted in 150 ml of fluid and compared to the average BAC curve generated from eight adult males averaging 74.6 kg in weight. Figure 4 shows good agreement between the model and the

experimental data. Comparison of the model and experimental data using root means square (RMS) differences gave R^2 values of 0.94, 0.95, 0.94 and 0.99 for each of the doses previously mentioned. The concentration curves generated by the metabolism model were then used to drive the skin diffusion model.

the time lag between peak BAC and TAC. Using four different doses we showed that the lag time was approximately the same for 5^{th}, 50^{th} and 95^{th} percentile drivers. This assumes that the metabolic rate and liver size is the same for all three body weights.

DOSE – The amount of ethanol ingested had a significant effect on the lag time; as the dose increased so did the lag time. We varied the dose of ethanol given to 5^{th}, 50^{th} and 95^{th} percentile drivers and calculated the lag time between peak BAC and TAC. In our study, increasing the dose from 15 ml to 60 ml of 95% ethanol increased the lag time by approximately half an hour. As we showed previously, increasing the dose increases the peak BAC and increases the time to max BAC. However, this relationship is not linear which becomes apparent when the BAC curves are applied to the skin model. Different BAC values are imposed on the skin model's blood boundary during the same periods of time for the different doses. Since ethanol diffusion through the skin is concentration driven this affects the time it takes for each of the dose curves to cross the skin. The time differences experienced at the skin for each curve combined with the delay in peak BAC time results in an increase in the lag time as the dose is increased.

METABOLIC RATE – We modeled differences in metabolic abilities among individuals by varying the V_{max} variable in the ethanol elimination expression by +/- 5%. This changed the rate at which ethanol was eliminated from the body. We noted that decreasing the metabolic rate increased lag time. These results are consistent with the values gathered from the dose-dependant study because decreasing the metabolic ability is similar to ingesting a larger dose of ethanol, which both result in a higher concentration of ethanol present in the body and a greater peak lag time. Similar to decreasing the ethanol dose, increasing the metabolic rate decreased the lag time. Changes in metabolic rate did not affect the lag time as significantly as changes

in the dose amount. Regardless, by decreasing the metabolic rate by 5% the lag time was changed by approximately 5%.

2.5 Optical ratio metric sensor for alcohol measurement

The measurement of ethanol concentration is of great importance in clinical, industrial, and biochemical areas as well as in the beverage industry. Ethanol is a useful solvent and is utilized in the production of perfumes, paints, lacquers, and explosives. Presently, the use of ethanol as a fuel, fuel additive, or a hydrogen source in fuel cells (Arico et al. 1998) has received renewed interest. Ethanol, as a fuel, has a substantial benefit over fossil fuels because it is an environmentally friendly, renewable resource. It may be produced by the fermentation of fruits, corn, or wheat, and is synthetically derived from acetaldehyde or ethylene. With numerous industries that utilize or produce ethanol, it is apparent that reliable methods are needed for its measurement and control.

Many analytical methods have been developed during the years for the measurement of ethanol and other alcohols. They can be classified in three major categories: chromatographic, enzymatic, and optical. The chromatographic method is the most accurate and sensitive (Buttler et al. 1993; Johansson et al. 1993), with a lower limit of ethanol detection on the order of 0.005% v/v (Zinbo 1994). Drawbacks of this method include high cost, as well as the necessity for sample pretreatment and long operation times. Somewhat less precise but more rapid measurements are chieved by the use of enzymes. Determination of ethanol concentration is based on either of two enzymes, alcohol oxidase or alcohol dehydrogenase, by monitoring O2 consumption or H2O2 formation (Azevedo et al. 2005; Boujitita et al. 2000). The specificity of the enzyme binding sites provides highly selective and accurate sensors. The disadvantage of the sensors lies in their instability due to protein denaturing when exposed to high temperature, pressure, or pH extremes. In recent years, attempts have been made to place the “sensing” enzymes in close proximity to a transducer (Guilbalt et al. 1983) or to immobilize them in a matrix (Belghith et al. 1987; Mitsubayashi et al. 1994). Immobilization increases the stability of the enzymes and allows for continuous monitoring. Screen-printing technology has also been used for the mass

production of low cost disposable enzymatic sensors (Boujitita et al. 2000). The simplest approach to the determination of alcohols is an optical sensor method. Optical sensors generally have the advantages of low-cost manufacturability, safety, and miniaturization and are intended for use in real-time, in situ monitoring. Recently, lifetime–based (Chang et al. 1997) and fluorescence-based (Mohr and Spichiger-Keller 1997; Mohr et al. 1997; Blum et al. 2001; Orellana et al. 1995) alcohol sensors have been introduced utilizing various alcohol-sensitive dyes. Although extremely promising, these sensors suffer from dye leaching, cross-sensitivity to pH, and low specificity. They also lack high temperature stability and are subject to interference due to auto fluorescence.

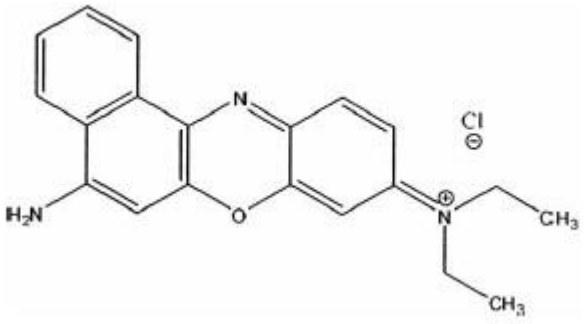

Figure 2.4 Chemical structure of Nile Blue Chloride (NB)

This article presents an autoclavable ratio metric optical alcohol sensor that operates in the red-infrared region of the visible spectrum. It utilizes Nile Blue Chloride (NB; Fig. 1), a fluorescent dye with an excitation maximum at 650 nm. The excitation wavelength in the red region of the spectrum results in minimal background fluorescence and higher signal to noise ratio. The dye is physically entrapped in a poly (ethylene glycol) (PEG) dimethacrylate hydrogel exhibiting practically no leaching. The resulting sensor is miniature and has high temperature and pressure resistance, allowing functionality after autoclaving. Furthermore, the sensor is hydrophilic and therefore has short response times to changes in solution alcohol concentration. When entrapped in the hydrogel, the dye exhibits two emission peaks, which allows for ratio metric measurements. The ratio metric approach circumvents many of the problems of the intensity-based methods (Kermis et al. 2002; Kostov and Rao 1999), including signal variations due to dye bleaching, fluctuations in source intensity or temperature,

and coloring of the media. The developed sensor was further characterized in terms of ethanol sensitivity, alcohol selectivity, response time, and cross-sensitivity to pH, polarity and ionic strength of the environment.

2.6 Transdermal alcohol sensing instrument

A system method that will prevent a human being from operating a motor vehicle if that human being is intoxicated or under the effect of hallucinating drugs. The system includes the use of a galvanic detector that can continuously measure the alcohol or toxicity level of the human being in conjunction with override switches to prevent the motor vehicle from being started or operated after impairment levels of alcohol are detected.

Although much progress has been made in the United States of America against drunk driver in the decade, drunk driving continues to be the number one factor in fatal automobile and vehicle wrecks in the United States. The deaths, injuries and destruction caused by drunk drivers is totally preventable. Though systems have been devised that disable a motor vehicle based on a driver's alcohol level, such systems, because of the complexity, have not been employed as too costly or too easy to circumvent. Some device have used coordination measurement which requires the user to push buttons in random order within a given amount of time in order to allow the vehicle to be started. Other systems have used detectors for analyzing the breathe of the vehicle operator in order to start the car.

A systems and method for use in a vehicle such as an automobile or truck that has a conventional combustion engine that employs as electrical spark system and ignition system for preventing the vehicle from being driven by a person who has consumed alcohol beyond a point of legal baseline.

The systems include a galvanic skin sensor that can provide trans-dermal monitoring of person's skin for ascertaining whether or not the person has consumed alcohol and the person's skin temperature. The sensor is connected through an actuating switch control system that is mounted electrically, typically within the vehicle ignition system that can act as a cutoff switch based in the various inputs from the trans-dermal sensor.

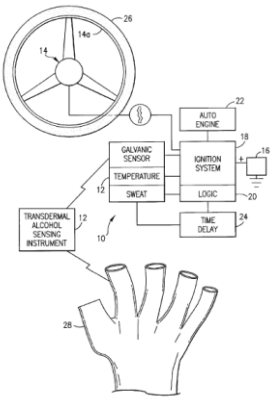

Figure 2.5 Transdermal alcohol sensing instrument diagram

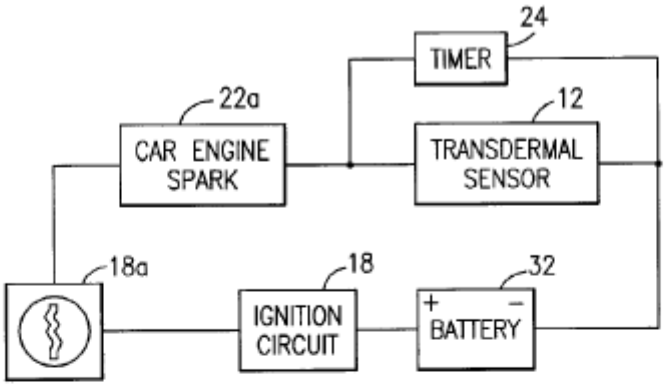

Figure 2.6 Circuit diagram in accordance with the present invention

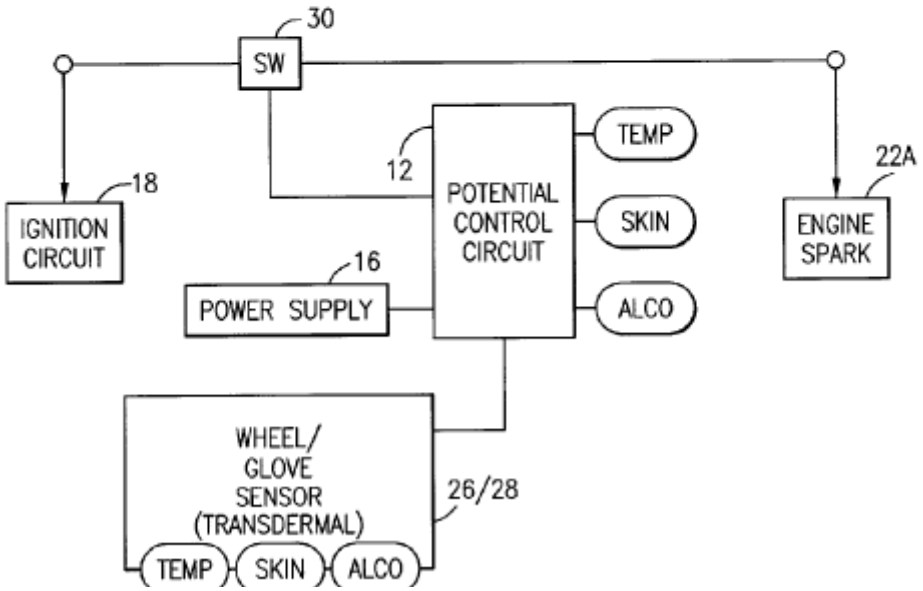

Figure 2.7 Schematic circuit and operational diagram of the present invention as used in an automobile

The time lag between the blood and skin ethanol concentrations is not constant for all situations, making it difficult to develop a reliable algorithm to calculate BAC based on a TAC measurement. An ethanol measurement made at the surface of the skin could be mapped to a range of BAC values depending on the amount of alcohol consumed, as shown in the dose effect studies presented previously. Therefore, an ethanol concentration measurement made at the surface of the skin under quiescent conditions can not be equated to a real-time BAC value without additional information about how much the subject had to drink. Transdermal measurements made in this manner cannot accuratelymeasure BAC in real-time. However, this detection method could prove useful as a dichotomous test to sense if the driver has been drinking.

Additionally, an easy way to circumvent a transdermal measurement would be to block direct skin contact with the sensor. An intoxicated driver wearing gloves could potentially prevent the sensors for detecting any ethanol on their skin at all. A secondary sensor system would be required to ensure that the measurement is being made at the surface of the skin.

Transdermal sensing of the alcohol in a driver's blood is one possible way to non-invasively detect intoxicated drivers. However, the feasibility of this method suffers from the time delay required for the alcohol in the driver's blood to diffuse to the surface of the skin where it can be easily and non-invasively measured. To explore the feasibility of transdermal sensing, we developed and validated a model capable of predicting the time difference between the peak blood alcohol concentration and peak skin alcohol concentration in human subjects given a single dose of ethanol. The model and our findings are limited to the study of a single dose of ethanol; therefore our findings may not be applicable to drivers who ingest multiple drinks. We used this model to study the effects that body weight, amount of alcohol consumed and differences in ethanol metabolic rates have on the lag time between peak BAC and TAC values. We found that, for a given dose of alcohol, lag time is insensitive to body weight. However, the dose size has a significant impact on the blood-skin concentration lag. A larger dose of alcohol causes an increase in the lag time. A 15 ml dose of 95% ethanol

The model used for these simulations is a simple ethanol metabolism and skin diffusion model, which has several limitations. The model was developed using

metabolic rate and transport coefficients developed from a limited number of experiments performed on subjects who fall into the 50^{th} percentile driver weight class. Because of this, it is unknown how accurate our results are for the 5^{th} and 95^{th} percentile weight groups. Additionally, the model does not account for human variability in ethanol metabolism and transport; in particular, differences in gender or ethnicity. Our model also assumes that the stomach is empty when the dose of ethanol is given, which ignores the effects of a full stomach on ethanol absorption. Finally, our model uses a rudimentary mass scaling approach to generate the differences between the weight groups which will be improved in future projects to more accurately describe how liver size and metabolic abilities vary with body weight.

2.7 Hand wave skin sensor

The core of the Hand Wave consists of two sandwiched printed circuit boards, one containing amplification circuitry, and one containing the Bluetooth module. The amplifier board provides the power connections and the terminal for the pair of electrodes. The device resides within an injection molded polypropylene housing, which includes an external power switch and electrode connection port. We have designed the Hand Wave electronics and periphery in order to facilitate ease of use. For such a technology to become widespread, universality is essential. We decided to use Bluetooth technology and a standard battery size in order to increase the universality of the Hand Wave. These features allow the Hand Wave to be an off-the-shelf device, equipped for maximum operation with minimal support.

The signal amplification on the Hand Wave has two stages, implemented on a dual-package operational amplifier. The first stage of amplification uses a 0.5 Volt reference to maintain a constant voltage across the skin. In accordance with an inverting amplifier configuration, the voltage gain of this stage is controlled by a resistance ratio. One of these resistances is provided by the subject's skin, as measured between a pair of electrodes. The other is subject to alteration by an analog switch, controlled by the PIC, which provides four different gain modes by switching different resistors into the circuit. The schematic for this first amplification stage is shown in

Figure 8. The second amplification stage is used to invert, scale, and shift the EDA signal in order to match the PIC ADC usable voltage range. The Hand Wave can measure skin conductance levels between 0 and 40 microsiemens (μS). The four gain modes have ranges of 0-5, 4-10, 8-20, and 16-40 μS. The gain mode information is transferred in parallel with ADC readings so the receiving computer can reconstruct the absolute measured skin conductance level.

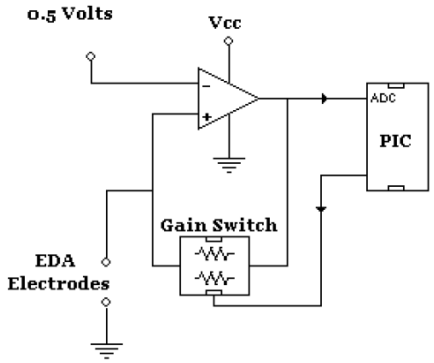

Figure 2.8 First EDA signal amplification stage.

The ADC on the PIC has 10-bit resolution. In order to detect EDA up to 20 Hz in frequency and attenuate signal noise to a level less than that which would alter the least significant bit, the PIC ADC samples at 1280 Hz. The PIC software averages every 32 samples, and the averages are sent over the wireless link at a rate of 40 Hz. In actuality, skin conductivity need not be measured at frequencies exceeding 5 Hz (Burleson, 2004). In the final prototype, the EDA signal resolution and sampling speed are high enough that minute changes in skin conductance from individual deep breaths are detected by the Hand Wave, as shown in Figure 9:

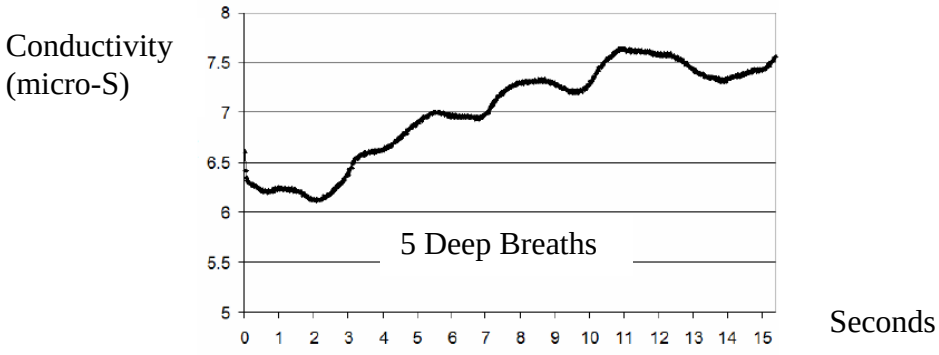

Figure 2.9 EDA signal from the Hand Wave during breathing.

Many design considerations were combined in order to reduce the size of the Hand Wave. The geometry of the circuit boards, as well as their dense component Arrangement significantly reduces the size of the device. The interface for in-circuit PIC programming consists of solder pads on the surface of the amplification board. Spring-loaded probes in a custom jig make electrical contact with these pads during programming. These design factors help to make the Hand Wave smaller and thereby less obtrusive to the wearer.

The Bluetooth transceiver used for the Hand Wave is a Mitsumi WML-C20A module. This module is integrated with an antenna and a processor with 512 kB of flash ROM. During normal operation, the module streams the EDA output received from the PIC over the wireless link to a nearby Bluetooth-equipped computer. Being a class-1 module, the WML-C20A is specified to be able to maintain connections at up to 100 meters. The Bluetooth module can also send information received over the wireless link to the PIC, resulting in bi-directional data transfer capabilities.

The Hand Wave can be powered by any voltage source between 3.3 and 16 Volts. The device has been measured to draw approximately 70 mA of current during normal operation. The majority of the current is drawn by the Bluetooth module, which is specified to consume up to 150 mA.

The original form factor for the Hand Wave was a wristwatch. This allows a sturdy, adjustable fixation to the wrist, in close proximity to the hand where the

electrodes are placed. However, the power consumption of the device necessitated replacement of the coin cell batteries after two hours of operation.

We next tested the Hand Wave in a handheld orb, with only electrodes and a power switch exposed. The orb allowed the use of a larger battery, which only had to be replaced occasionally. However, we found that the subject, while holding the orb, was able to significantly increase his EDA reading by squeezing the orb, thereby improving the fidelity of the electrode connection. These motion artifacts, compounded with the inconvenience of accessing the embedded device for maintenance, prompted the design and manufacture of a dedicated housing for the HandWave sensor.

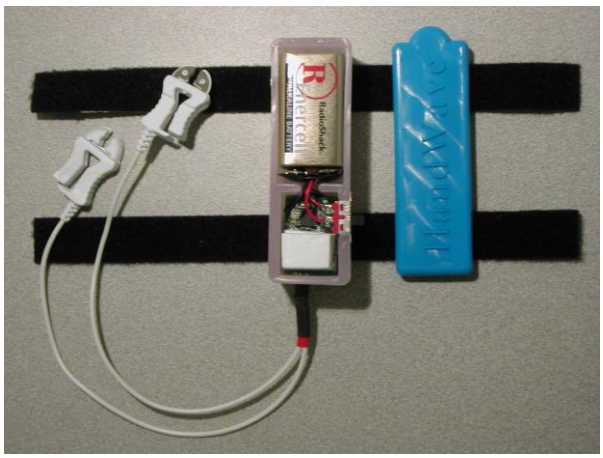

Figure 2.10 The Hand Wave, replete with housing, battery, wrist straps and electrode leads.

The most recent revision of the Hand Wave housing is shown in Figure 10. It is injection-molded out of polypropylene, and includes one cavity for the Hand Wave circuit boards, one cavity for a 9V battery, and one cavity for a power switch. There is also a single port on the side of the housing for connecting the electrodes to the amplifier board. The housing can be mounted on the wrist with Velcro straps or clips. The lid attaches to the housing body by means of a snap fit, and the power switch, circuit boards, and battery are press-fit into their respective cavities. The 9V battery provides power for approximately 10 hours of operation, and the press/snap fit assembly allows easy access to the interior elements. Finally, the electrodes are not

situated on the housing itself, which prevents the wearer from inducing significant motion artifacts in the EDA signal.

2.8 Infrared pulse detector

Modern pulse oxy-meter plays an important part in modern medicine, specifically in the operating room. One of the most important people in an operating room is the anesthesiologist. They are in change of keeping the patient alive within specified limits; therefore, they must monitor many vital statistics, two of which are pulse and oxygen content in hemoglobin in the blood.

The circuit presented here is a simplified version of pulse detector. The pulse detector is noninvasive, easy to use, and made from item readily available. The instructions are presented:

- Finger clip assembly and connector.
- The signal amplifier.
- The comparator and the LED output.
- Testing and Suggestions.

When testing the circuit, one must remember that it is designed to detect the heartbeat or the pulse using a person's finger; the difficulty arises in the fact that everybody is different. Not only will the setting vary from person to person, but they will also vary from finger to finger.

The pulse oximeter is an instrument that incorporates both oximetry and plethysmography to provide continuous non-invasive monitoring of oxygen saturation in patients who require such monitoring. Oxygen saturation values obtained from pulse oximetry are part of a complete assessment of a patient's oxygenation status but are not a substitute for full arterial blood gas analysis. Pulse oximetry can be useful in early detection of arterial hypoxemia in many areas of clinical practice; however certain limitations from either technical or patient-related sources must also be considered.

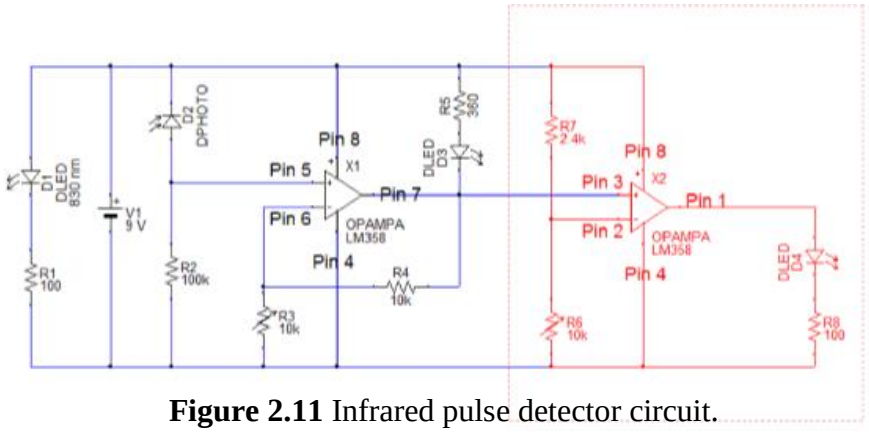

Figure 2.11 Infrared pulse detector circuit.

2.9 Basic concept

To increase accuracy for this system can be integrated into the infrared detection efficiency of the interlock system. Cost is cheap.

To create IPD stick LED diode on upper fore finger of right hand, photo diode on lower fore finger in right hand. When we put right hand into a glove and switch on. The system will be analyst thermal and pulse. If thermal rate less than 36.2c and heart rate (pulse) more than 90 bpm system will be shutdown. And use IPD connects line out to interlock system.

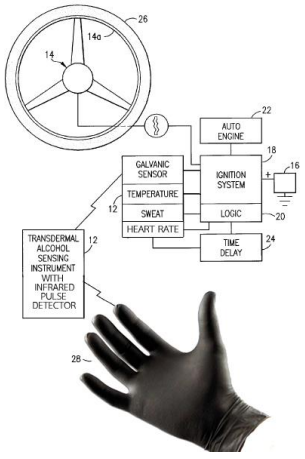

Figure 2.12 Basic concept of thermal detector and Infrared pulse detector circuit.

CHAPTER III
METERIALS AND METHOD

3.1 Project Initialization

"A Deadlock system for drunk driver using pulse detector combination with thermal detector" is developed for driver who drunk while driving. It can help impairment of pulse and thermal in appropriate physical examination technique. Information and characteristics of each condition in alcohol consumables will be studied and collected.

3.2 System design

"A Deadlock system for drunk driver using pulse detector combination with thermal detector" has processes in system analysis and design as follows;

3.2.1 Knowledge Engineering

"A Deadlock system for drunk driver using pulse detector combination with thermal detector" collected information from several sources such as journals, books, and interviewing with drunk driver. It collected information about characteristics of each condition in pulse and thermal of body, value impairment and physical examination technique and process of knowledge engineering as follows.

3.2.1.1 Knowledge Acquisition. Knowledge acquisition involves the acquisition of knowledge from journals and books. By collect knowledge from books, documents and journal will have to study those documents to screen out knowledge of books, documents and journal

3.2.1.2 Knowledge Validation. The Knowledge is validate and verified by expert of medical, physical therapy until its quality is acceptable.

3.2.1.3 Knowledge Representation. This activity involves preparation of Infrared Pulse Detector and Thermal Detector.

3.2.1.4 Inference. System can detect alcohol consumables by pulse and thermal of body skin.

3.2.1.5 Explanation and Justification. System has ability to decide to start or stop ignition system in vehicle.

3.2.2 Analysis and generating rules

The system will analyze the data and generate into rules by using decision table. The system is also capable of substitution by regulation with forward chaining mechanism.

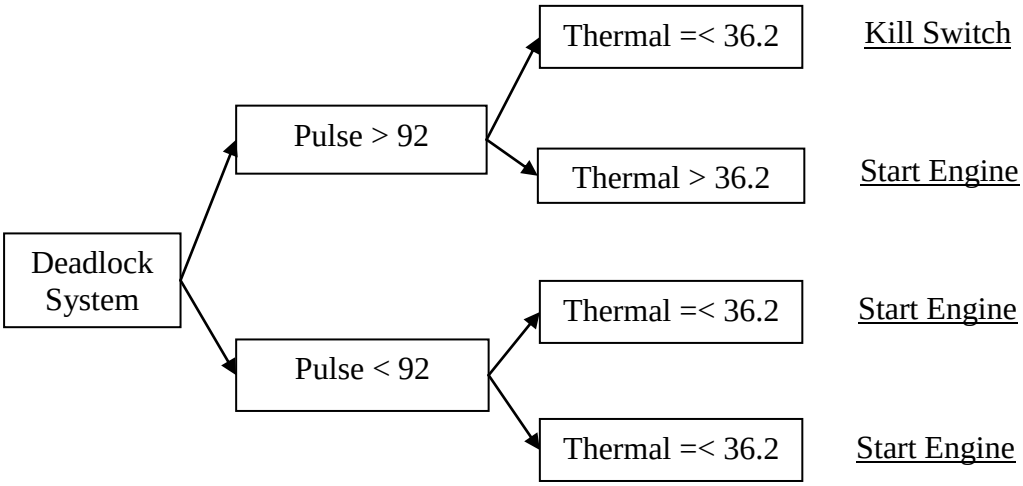

Figure 3.1 Dead lock system decision Tree

RULE [1]
IF [Pulse Value =< “90”, Thermal Value > “36.2”]
THEN [Engine Start]
RULE [2]
IF [Pulse Value > “90”, Thermal Value > “36.2”]
THEN [Engine Start]
RULE [3]
IF [Pulse Value < “90”, Thermal Value =< “36.1”]
THEN [Engine Start]

RULE [4]

IF [Pulse Value > “90”, Thermal Value =< “36.2”]

THEN [Kill Switch]

3.2.3 Deadlock system design

The process of “A Deadlock system for drunk driver using pulse detector combination with thermal detector” shows as Figure 3.2

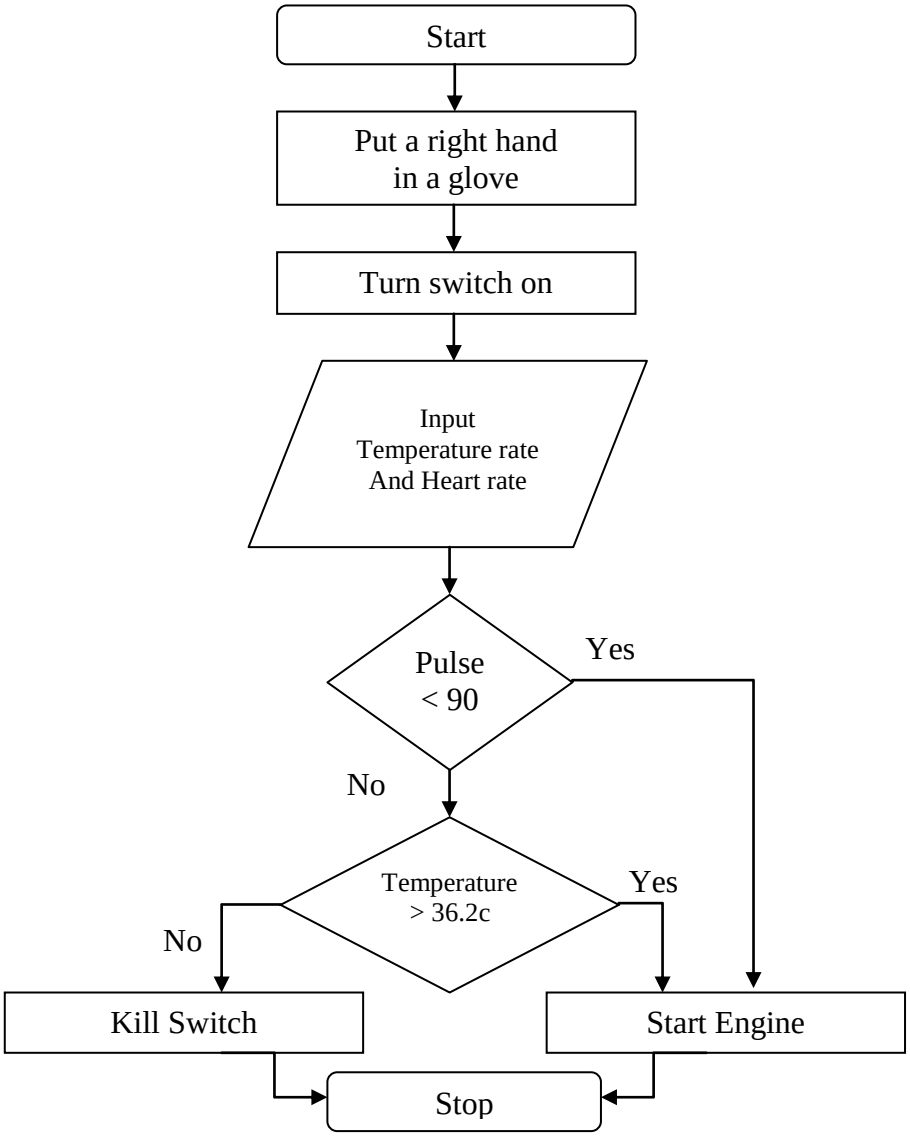

Figure 3.2 The process of “A Deadlock system for drunk driver using pulse detector combination with thermal detector”

3.3 Measurement apparatus

Propagation experiments in alcohol measuring were carried out with measurement apparatus including infrared pulse (IPD) system and transdermal sensing instrument.

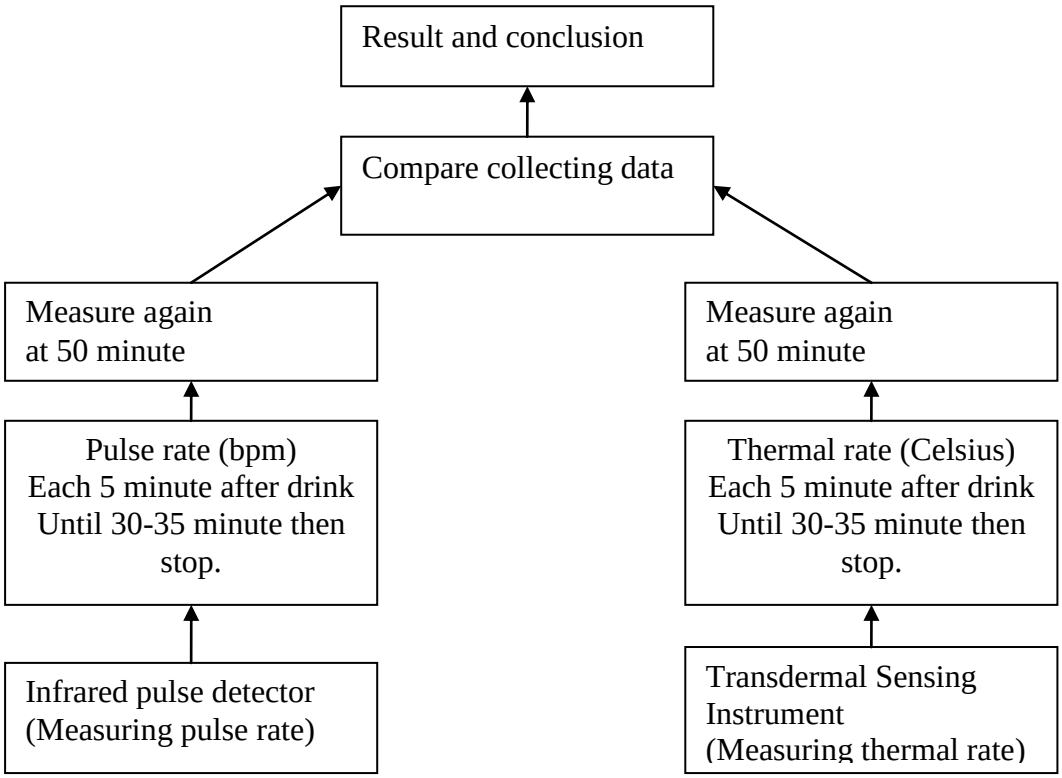

Figure 3.3 Measuring model

3.3.1 Infrared Pulse Detector

The pulse oximeter is an instrument that incorporates both oximetry and plethysmography to provide continuous non-invasive monitoring of oxygen saturation in patients who require such monitoring. Oxygen saturation values obtained from pulse oximetry are part of a complete assessment of a patient's oxygenation status but are not a substitute for full arterial blood gas analysis

It use to measuring pulse rate. Put a forefinger of right hand in IPD and measure before drink alcohol then drink after 5 minute measure again until at 30 minute. Now subject will stop drinking alcohol until at 50 minute and measure again

In this research measuring each 5 minute until stop measuring at 30 minute. And no food while collecting data and measure again at 50 minute.

Figure 3.4 Infrared pulse detector or Oximeter.

3.3.1 Thermometer

Compare collecting data between digital and analogue thermometer. Method same IPD.

Figure 3.5 Analogue thermometer.

Figure 3.6 Digital thermometer.

Analogue thermometer takes time more than Digital thermometer but they have similar data.

3.4 Description of the Alcohol

In theory, then began drinking alcohol when the available volume of ice is 0.61 liters, for a period of at least 30 minutes. The rate of alcohol metabolism is not the same individual. Depending on the range accepted in the drink, the food or not.

The pulse rate is higher than the normal time drunk quite a lot. (Faculty of Medicine. Siriraj Hospital). Rate of body temperature is below 37.0 Celsius. (Board of Nursing. PSU).

3.5 Data comparison

The reason why the researcher used IPD to this research because it takes short time to measuring pulse rate and accuracy. And collecting data was testing by expertise physical therapists.

3.6 Research Tools

3.6.1 Hardware

Personal Computer

CPU	:	Core2Duo 2.0 GHz	
RAM	:	4.00	GB
Hard disk	:	250	GB

Oximeter (Pulse Detector)

Thermometer (Digital and analogue)

Spark Engine

3.6.2 Software

OS	:	Microsoft Windows 7 Ent.

Tools : Microsoft Excel 2010
Microsoft Visio 2010
Weka 3.6.9

3.6.3 Other research tools

Smirnoff whisky 270 ml alcohol 5 – 15 %

CHAPTER IV
RESULTS

The development of "A Deadlock system for drunk driver using pulse detector combination with thermal detector" has used measuring pulse and thermal in right hand (fore finger or other fingers but not thumb) form Chapter 3. This system lead to the realization of the following ways, means, limitations and problems.

4.1 Results Measuring

4.1.1 Sources of knowledge

From the study regarding the screening of drunk driver, the researcher has learned and collected various data. Those important ones include;

Pulse rate

Thermal rate

4.1.2 Knowledge represents

"A Deadlock system for drunk driver using pulse detector combination with thermal detector" provides some data which can be presented in the form table. This is for the purpose of making sure that IPD accuracy to use with transdermal sensing instrument.

4.1.3 Pulse rate result

Table 4.1 Pulse rate of all subjects

Time(minute)			0	5	10	15	20	25	30	50
No.	Sex	Age								
1	Male	18	80	83	85	90	92	97	97	99
2	Female	18	82	85	85	87	91	94	97	97

Table 4.1 Pulse rate of all subjects (cont.)

3	Male	20	75	76	80	84	90	90	91	89
4	Female	20	77	80	88	92	94	97	97	99
5	Male	21	86	89	98	98	102	110	112	118
6	Female	24	75	75	80	89	90	91	91	92
7	Male	27	76	82	85	88	97	112	108	110
8	Female	30	74	79	86	88	90	90	92	95
9	Male	32	73	75	80	82	88	92	97	99
10	Male	34	69	74	74	83	94	97	98	98
11	Male	34	74	77	80	82	88	94	98	101
12	Male	35	77	76	79	81	87	91	92	97
13	Male	36	78	77	85	86	92	91	91	98
14	Male	37	77	77	80	82	88	90	97	99
15	Female	37	74	74	78	82	88	92	95	101
16	Female	38	76	75	79	81	86	91	98	100
17	Male	39	78	76	80	80	84	90	101	99
18	Male	40	76	77	81	82	84	91	97	98
19	Female	40	77	78	82	82	85	91	95	97
20	Male	40	74	76	79	82	88	90	90	94
21	Female	41	71	74	79	83	89	91	92	95
22	Male	42	68	72	78	81	88	94	95	97
23	Female	42	65	70	77	83	87	97	94	97
24	Male	42	74	80	80	87	91	95	98	96
25	Female	43	76	77	80	82	88	94	95	97
26	Male	44	77	80	80	89	90	90	93	98
27	Female	44	77	77	79	83	84	91	93	97
28	Male	44	72	77	80	84	86	92	93	101
29	Female	45	71	74	79	86	92	93	92	97
30	Male	45	78	77	85	88	97	98	98	101
31	Female	46	77	77	80	80	84	90	93	98
32	Male	47	76	77	80	83	84	91	91	100
33	Female	47	73	76	85	88	90	90	94	94
34	Male	47	67	70	74	83	88	93	98	98
35	Female	48	65	70	77	80	84	90	98	95
36	Male	49	78	76	80	82	84	91	91	98
37	Female	49	69	72	79	84	89	94	89	99
38	Male	49	68	74	74	83	88	91	92	97
39	Female	49	72	72	74	87	91	92	92	99
40	Male	50	70	71	72	80	82	90	92	94
41	Female	50	73	72	79	88	94	101	98	98
42	Male	50	69	71	77	87	94	97	100	98

Table 4.1 Pulse rate of all subjects (cont.)

43	Female	51	73	72	77	82	88	97	99	112
44	Male	51	72	72	72	80	88	90	94	98
45	Male	52	69	74	80	83	87	91	94	97
46	Female	52	70	70	71	84	86	92	97	99
47	Female	53	72	77	80	82	88	88	95	94
48	Male	53	69	71	76	83	89	93	99	111
49	Male	54	69	70	77	83	93	97	99	104
50	Male	54	67	67	73	84	92	97	94	98
51	Male	55	68	69	77	82	89	98	97	101
52	Male	55	67	71	79	88	91	93	97	103
53	Male	55	68	71	74	80	87	94	101	101
54	Male	55	70	70	74	81	88	91	96	97
55	Female	42	65	70	77	83	87	97	94	97
56	Male	42	74	80	80	87	91	95	98	96
57	Female	43	76	77	80	82	88	94	95	97
58	Male	44	77	80	80	89	90	90	93	98
59	Female	44	77	77	79	83	84	91	93	97
60	Male	44	72	77	80	84	86	92	93	101
61	Female	45	71	74	79	86	92	93	92	97
62	Male	45	78	77	85	88	97	98	98	101
63	Female	46	77	77	80	80	84	90	93	98
64	Male	55	67	71	79	88	91	93	97	103
65	Male	55	68	71	74	80	87	94	101	101
66	Male	55	70	70	74	81	88	91	96	97
67	Female	42	65	70	77	83	87	97	94	97
68	Male	42	74	80	80	87	91	95	98	96
69	Female	43	76	77	80	82	88	94	95	97
70	Male	44	77	80	80	89	90	90	93	98
71	Female	44	77	77	79	83	84	91	93	97
72	Male	50	70	71	72	80	82	90	92	94
73	Female	50	73	72	79	88	94	101	98	98
74	Male	50	69	71	77	87	94	97	100	98
75	Female	51	73	72	77	82	88	97	99	112
76	Male	51	72	72	72	80	88	90	94	98
77	Female	30	74	79	86	88	90	90	92	95
78	Male	32	73	75	80	82	88	92	97	99
79	Male	34	69	74	74	83	94	97	98	98
80	Male	34	74	77	80	82	88	94	98	101
81	Male	35	77	76	79	81	87	91	92	97

Table 4.1 Pulse rate of all subjects (cont.)

82	Male	36	78	77	85	86	92	91	91	98
83	Male	37	77	77	80	82	88	90	97	99
84	Female	37	74	74	78	82	88	92	95	101
85	Female	38	76	75	79	81	86	91	98	100
86	Male	39	78	76	80	80	84	90	101	99
87	Male	40	76	77	81	82	84	91	97	98
88	Female	40	77	78	82	82	85	91	95	97
89	Male	55	67	71	79	88	91	93	97	103
90	Male	55	68	71	74	80	87	94	101	101
91	Male	55	70	70	74	81	88	91	96	97
92	Female	42	65	70	77	83	87	97	94	97
93	Male	42	74	80	80	87	91	95	98	96
94	Female	43	76	77	80	82	88	94	95	97
95	Male	44	77	80	80	89	90	90	93	98
96	Female	44	77	77	79	83	84	91	93	97
97	Male	55	67	71	79	88	91	93	97	103
98	Male	55	68	71	74	80	87	94	101	101
99	Male	55	70	70	74	81	88	91	96	97
100	Female	42	65	70	77	83	87	97	94	97
101	Male	42	74	80	80	87	91	95	98	96
102	Female	43	76	77	80	82	88	94	95	97
103	Male	44	77	80	80	89	90	90	93	98

Table 4.2 Pulse rate with classify age

Time(minute)		0	5	10	15	20	25	30	50
No.	Age								
1	Avg 18-30	78	81	86	90	93	98	98	100
2	Avg 31-40	75	76	80	82	88	92	96	98
3	Avg 41-50	72	74	78	84	88	93	94	97
4	Avg 51-55	70	71	76	83	89	93	97	101
Average all		73	75	79	84	89	93	96	99
Standard Deviation		4	4	5	4	4	4	4	5

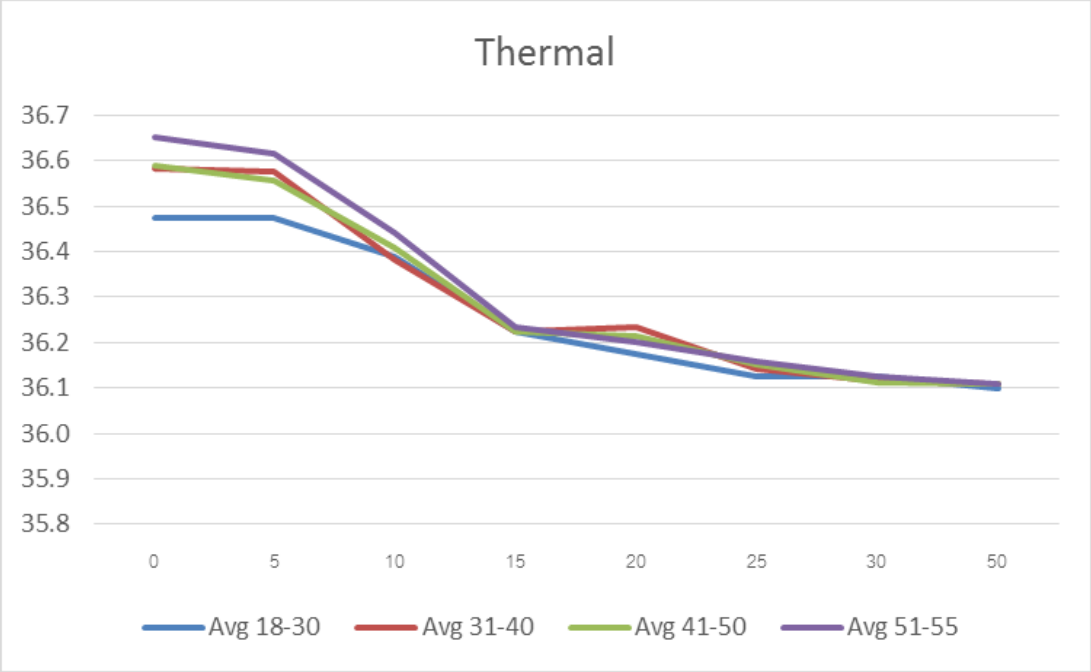

Figure 4.1 Pulse rate with classify age

Table 4.3 Pulse rate with classify gender

Time(minute)		0	5	10	15	20	25	30	50
No.	Age								
1	Female	73	75	80	84	88	93	95	98
2	Male	73	75	79	84	89	94	96	100
Standard Deviation		4	4	5	4	4	4	4	5

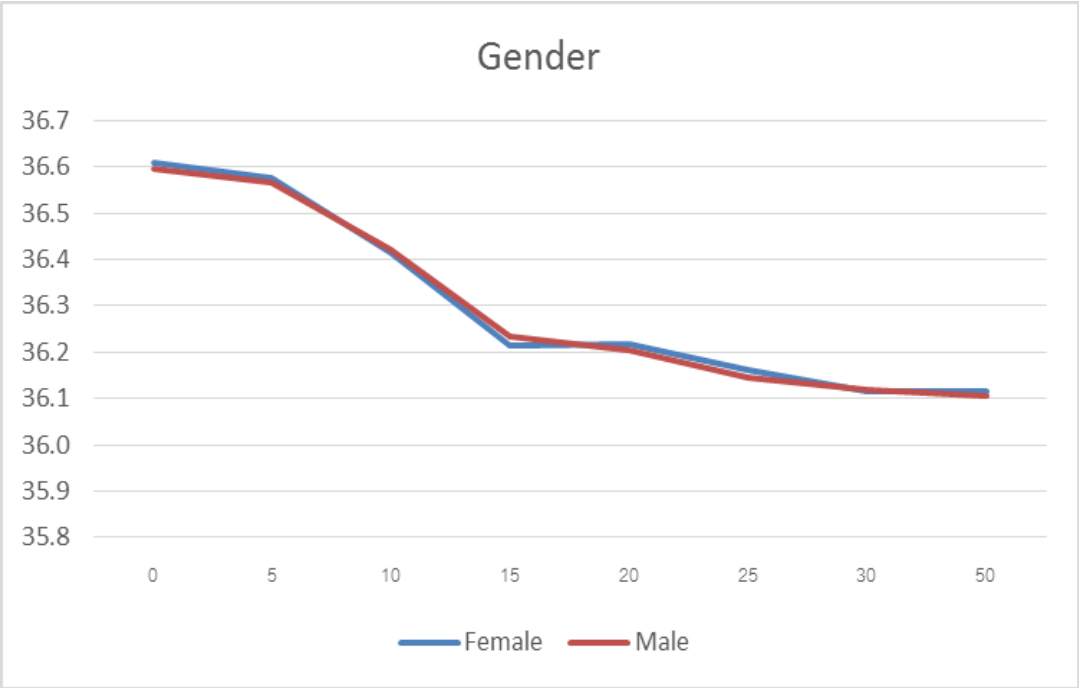

Figure 4.2 Pulse rate with classify gender

4.1.4 Result of thermal

Table 4.4 Thermal rate of all subjects

Time(minute)			0	5	10	15	20	25	30	50
No.	Sex	Age								
1	Male	18	36.7	36.7	36.5	36.2	36.2	36.1	36.2	36.1
2	Female	18	36.5	36.5	36.5	36.2	36.2	36.1	36.1	36.1
3	Male	20	36.4	36.4	36.3	36.3	36.2	36.1	36.1	36.1
4	Female	20	36.7	36.7	36.4	36.2	36.2	36.1	36.2	36.1
5	Male	21	36.4	36.4	36.7	36.5	36.2	36.1	36.1	36.1
6	Female	24	36.5	36.5	36.4	36.2	36.2	36.3	36.1	36.1
7	Male	27	36.3	36.3	36.1	36.1	36.1	36.1	36.1	36.1
8	Female	30	36.3	36.3	36.2	36.1	36.1	36.1	36.1	36.1
9	Male	32	36.7	36.7	36.5	36.2	36.3	36.2	36.1	36.1
10	Male	34	36.6	36.6	36.5	36.2	36.1	36.1	36.2	36.1
11	Male	34	36.5	36.5	36.4	36.2	36.2	36.1	36.1	36.1
12	Male	35	36.7	36.7	36.3	36.3	36.3	36.2	36.1	36.1
13	Male	36	36.3	36.3	36.1	36.1	36.1	36.1	36.1	36.1
14	Male	37	36.5	36.5	36.5	36.2	36.3	36.1	36.1	36.1
15	Female	37	36.7	36.6	36.3	36.3	36.3	36.1	36.1	36.1

Table 4.4 Thermal rate of all subjects (cont.)

16	Female	38	36.5	36.5	36.4	36.2	36.3	36.2	36.1	36.1
17	Male	39	36.7	36.7	36.3	36.3	36.2	36.2	36.1	36.1
18	Male	40	36.6	36.6	36.5	36.2	36.2	36.2	36.2	36.2
19	Female	40	36.6	36.6	36.3	36.3	36.3	36.1	36.1	36.1
20	Male	40	36.6	36.6	36.5	36.2	36.2	36.1	36.1	36.1
21	Female	41	36.6	36.6	36.4	36.2	36.3	36.2	36.1	36.1
22	Male	42	36.5	36.5	36.3	36.3	36.2	36.2	36.1	36.1
23	Female	42	36.7	36.7	36.6	36.2	36.2	36.2	36.2	36.2
24	Male	42	36.6	36.6	36.4	36.2	36.3	36.1	36.1	36.1
25	Female	43	36.5	36.5	36.5	36.2	36.2	36.2	36.1	36.1
26	Male	44	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
27	Female	44	36.7	36.6	36.6	36.2	36.2	36.1	36.1	36.1
28	Male	44	36.5	36.5	36.4	36.3	36.3	36.2	36.1	36.1
29	Female	45	36.7	36.5	36.4	36.2	36.2	36.2	36.1	36.1
30	Male	45	36.7	36.6	36.6	36.2	36.2	36.2	36.1	36.1
31	Female	46	36.6	36.6	36.4	36.2	36.2	36.2	36.1	36.2
32	Male	47	36.7	36.5	36.4	36.2	36.3	36.2	36.1	36.2
33	Female	47	36.7	36.7	36.4	36.2	36.1	36.1	36.1	36.1
34	Male	47	36.5	36.5	36.5	36.2	36.2	36.1	36.1	36.1
35	Female	48	36.6	36.6	36.4	36.2	36.2	36.1	36.1	36.1
36	Male	49	36.7	36.5	36.4	36.2	36.2	36.1	36.1	36.1
37	Female	49	36.5	36.5	36.4	36.2	36.3	36.2	36.1	36.1
38	Male	49	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
39	Female	49	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
40	Male	50	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
41	Female	50	36.7	36.6	36.4	36.3	36.1	36.1	36.1	36.1
42	Male	50	36.7	36.6	36.4	36.2	36.1	36.2	36.1	36.1
43	Female	51	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
44	Male	51	36.5	36.5	36.5	36.2	36.1	36.1	36.1	36.1
45	Male	52	36.7	36.6	36.4	36.2	36.1	36.1	36.1	36.1
46	Female	52	36.6	36.6	36.5	36.3	36.2	36.2	36.1	36.1
47	Female	53	36.7	36.7	36.4	36.2	36.2	36.2	36.2	36.2
48	Male	53	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
49	Male	54	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
50	Male	54	36.7	36.6	36.4	36.2	36.2	36.1	36.1	36.1
51	Male	55	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
52	Male	55	36.7	36.7	36.4	36.2	36.3	36.2	36.1	36.1
53	Male	55	36.7	36.6	36.4	36.2	36.2	36.2	36.1	36.1
54	Male	55	36.6	36.6	36.5	36.3	36.2	36.1	36.1	36.1
55	Female	42	36.6	36.6	36.4	36.2	36.2	36.2	36.1	36.2

Table 4.4 Thermal rate of all subjects (cont.)

56	Male	42	36.7	36.5	36.4	36.2	36.3	36.2	36.1	36.2
57	Female	43	36.7	36.7	36.4	36.2	36.1	36.1	36.1	36.1
58	Male	44	36.5	36.5	36.5	36.2	36.2	36.1	36.1	36.1
59	Female	44	36.6	36.6	36.4	36.2	36.2	36.1	36.1	36.1
60	Male	44	36.7	36.5	36.4	36.2	36.2	36.1	36.1	36.1
61	Female	45	36.5	36.5	36.4	36.2	36.3	36.2	36.1	36.1
62	Male	45	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
63	Female	46	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
64	Male	55	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
65	Male	55	36.7	36.6	36.4	36.3	36.1	36.1	36.1	36.1
66	Male	55	36.7	36.6	36.4	36.2	36.1	36.2	36.1	36.1
67	Female	42	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
68	Male	42	36.5	36.5	36.5	36.2	36.1	36.1	36.1	36.1
69	Female	43	36.7	36.6	36.4	36.2	36.1	36.1	36.1	36.1
70	Male	44	36.7	36.7	36.4	36.2	36.1	36.1	36.1	36.1
71	Female	44	36.5	36.5	36.5	36.2	36.2	36.1	36.1	36.1
72	Male	50	36.6	36.6	36.4	36.2	36.2	36.1	36.1	36.1
73	Female	50	36.7	36.5	36.4	36.2	36.2	36.1	36.1	36.1
74	Male	50	36.5	36.5	36.4	36.2	36.3	36.2	36.1	36.1
75	Female	51	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
76	Male	51	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
77	Female	30	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
78	Male	32	36.7	36.6	36.4	36.3	36.1	36.1	36.1	36.1
79	Male	34	36.7	36.6	36.4	36.2	36.1	36.2	36.1	36.1
80	Male	34	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
81	Male	35	36.5	36.5	36.5	36.2	36.1	36.1	36.1	36.1
82	Male	36	36.7	36.6	36.4	36.2	36.1	36.1	36.1	36.1
83	Male	37	36.5	36.5	36.4	36.2	36.3	36.2	36.1	36.1
84	Female	37	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
85	Female	38	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
86	Male	39	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
87	Male	40	36.7	36.6	36.4	36.3	36.1	36.1	36.1	36.1
88	Female	40	36.7	36.6	36.4	36.2	36.1	36.2	36.1	36.1
89	Male	55	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
90	Male	55	36.5	36.5	36.5	36.2	36.1	36.1	36.1	36.1
91	Male	55	36.7	36.6	36.4	36.2	36.1	36.1	36.1	36.1
92	Female	42	36.7	36.7	36.4	36.2	36.1	36.1	36.1	36.1
93	Male	42	36.5	36.5	36.5	36.2	36.2	36.1	36.1	36.1
94	Female	43	36.6	36.6	36.4	36.2	36.2	36.1	36.1	36.1
95	Male	44	36.7	36.5	36.4	36.2	36.2	36.1	36.1	36.1

Table 4.4 Thermal rate of all subjects (cont.)

96	Female	44	36.5	36.5	36.4	36.2	36.3	36.2	36.1	36.1
97	Male	55	36.6	36.6	36.5	36.3	36.2	36.2	36.2	36.1
98	Male	55	36.7	36.6	36.4	36.2	36.3	36.2	36.1	36.1
99	Male	55	36.7	36.7	36.4	36.2	36.2	36.1	36.1	36.1
100	Female	42	36.7	36.6	36.4	36.3	36.1	36.1	36.1	36.1
101	Male	42	36.7	36.6	36.4	36.2	36.1	36.2	36.1	36.1
102	Female	43	36.5	36.5	36.5	36.2	36.1	36.1	36.1	36.1
103	Male	44	36.7	36.6	36.4	36.2	36.1	36.1	36.1	36.1

Table 4.5 Thermal rate with classify age

Time(minute)		0	5	10	15	20	25	30	50
No.	Age								
1	Avg 18-30	36.5	36.5	36.4	36.2	36.2	36.1	36.1	36.1
2	Avg 31-40	36.6	36.6	36.4	36.2	36.2	36.1	36.1	36.1
3	Avg 41-50	36.6	36.6	36.4	36.2	36.2	36.2	36.1	36.1
4	Avg 51-55	36.7	36.6	36.4	36.2	36.2	36.2	36.1	36.1
Average all		36.6	36.6	36.4	36.2	36.2	36.2	36.1	36.1
Standard Deviation		0.12	0.10	0.11	0.06	0.07	0.05	0.04	0.03

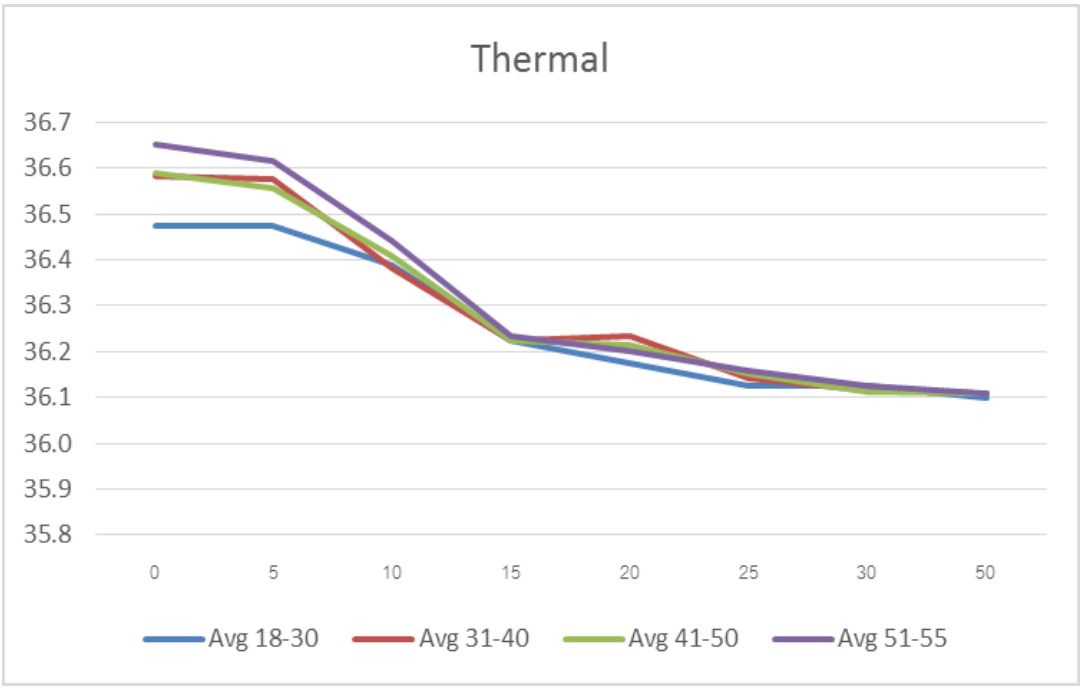

Figure 4.3 Thermal rate with classify age

Table 4.6 Thermal rate with gender

Time(minute)		0	5	10	15	20	25	30	50
No.	Age								
1	Female	36.6	36.6	36.4	36.2	36.2	36.2	36.1	36.1
2	Male	36.6	36.6	36.4	36.2	36.2	36.1	36.1	36.1
Standard Deviation		0.12	0.10	0.11	0.06	0.07	0.05	0.04	0.03

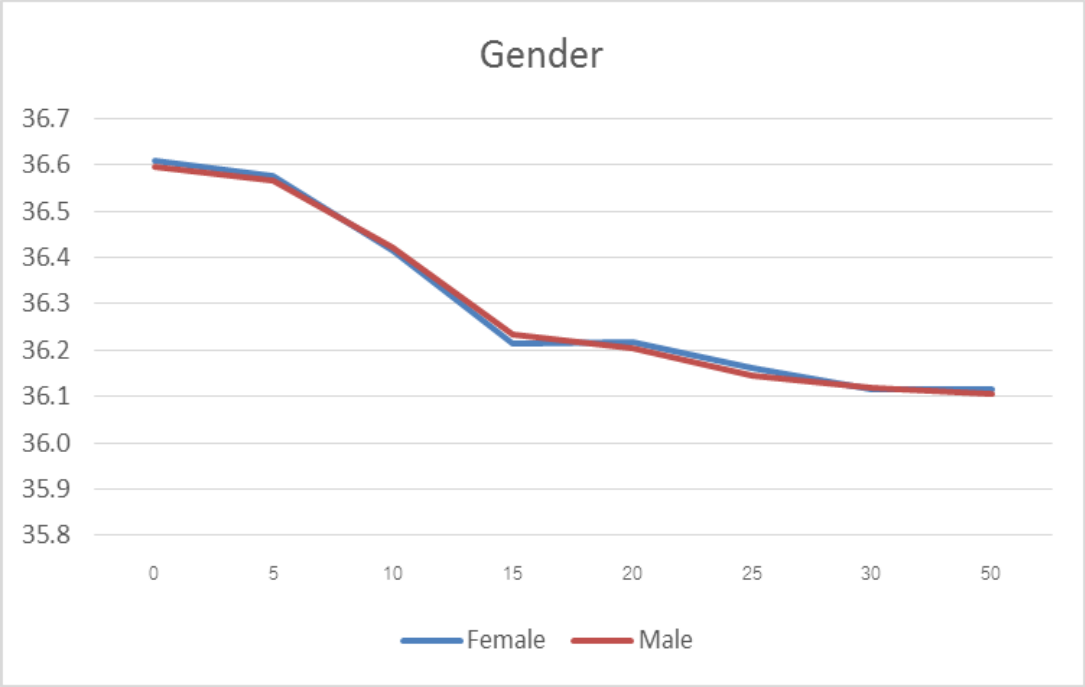

Figure 4.4 Thermal rate with classify gender

Table 4.7 Comparison of pulse rate and thermal rate

Time(minute)		0	5	10	15	20	25	30	50
No.	Age								
1	Thermal	36.6	36.6	36.4	36.2	36.2	36.2	36.1	36.1
2	Pulse	72	74	78	84	88	93	94	97

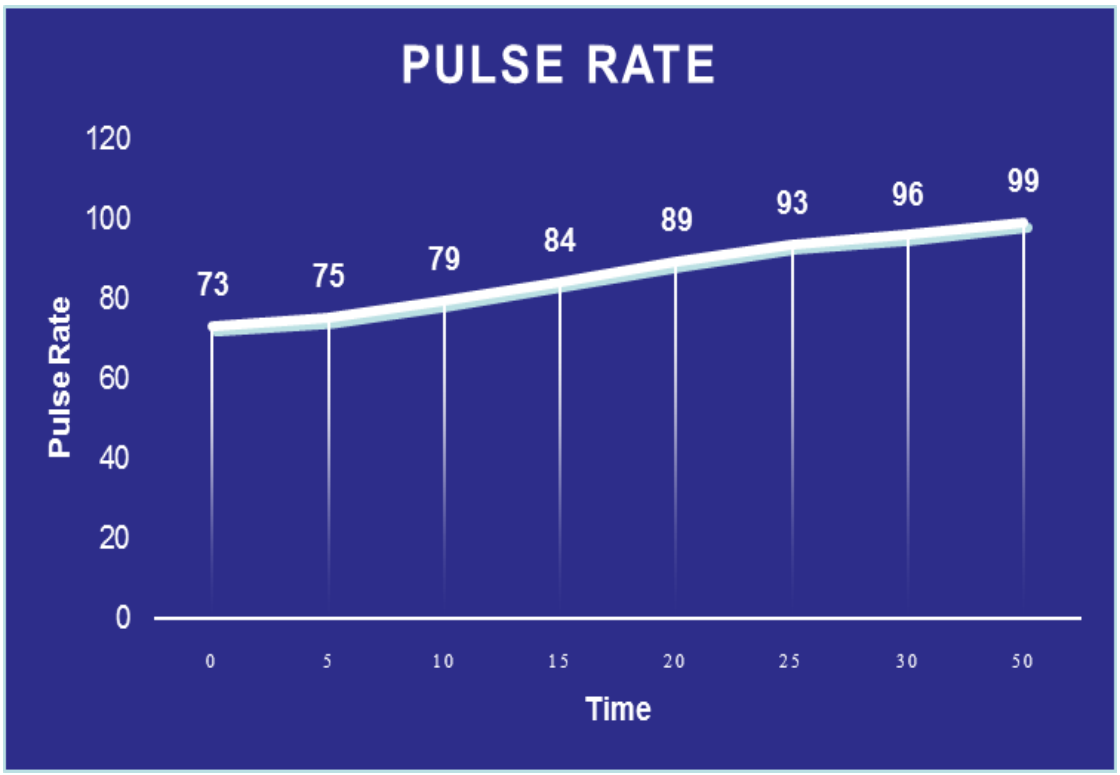

Figure 4.5 Pulse rate with all subjects

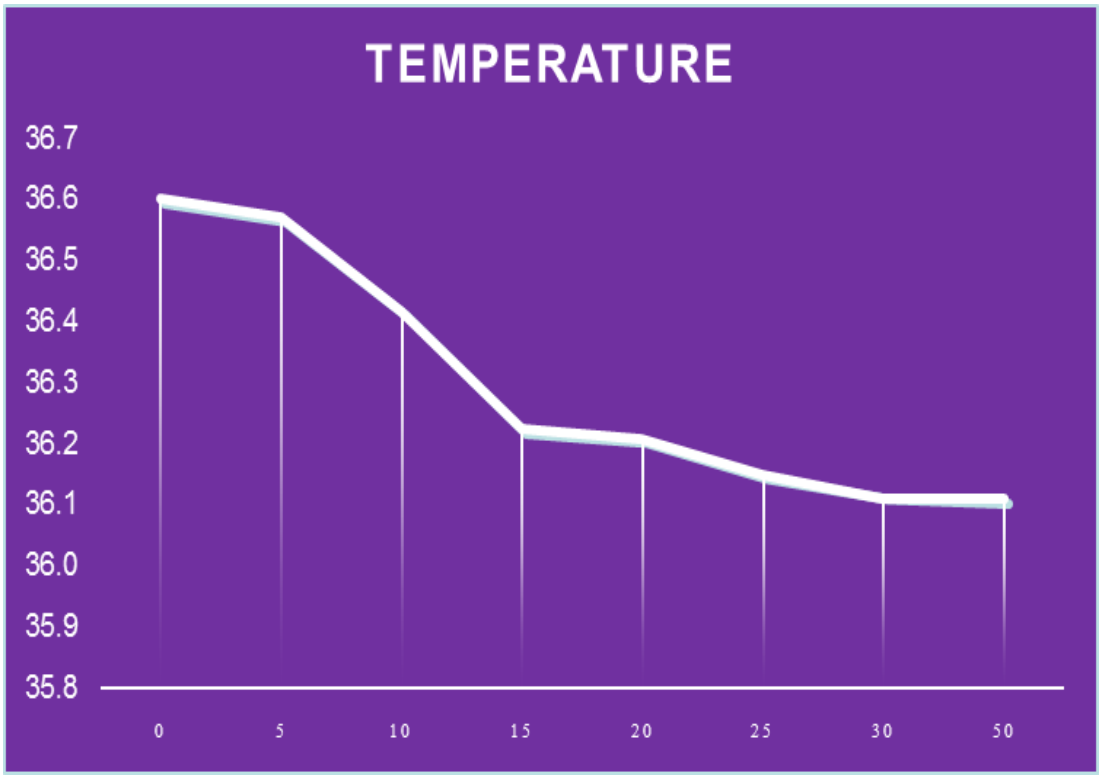

Figure 4.6 Thermal rate with all subjects

4.2 Decision tree

In this research, the pulse and temperature. I have a theory in line with the 25 to 30 minutes, which is the result of its research. To conclude that IPD accurately measure the pulse of the binge. That will be generate by using Weka.

4.2.1 Generate rule by Weka

Input pulse rate and thermal rate data in Weka. The data collected to run in Vega. By find comparison groups as following.

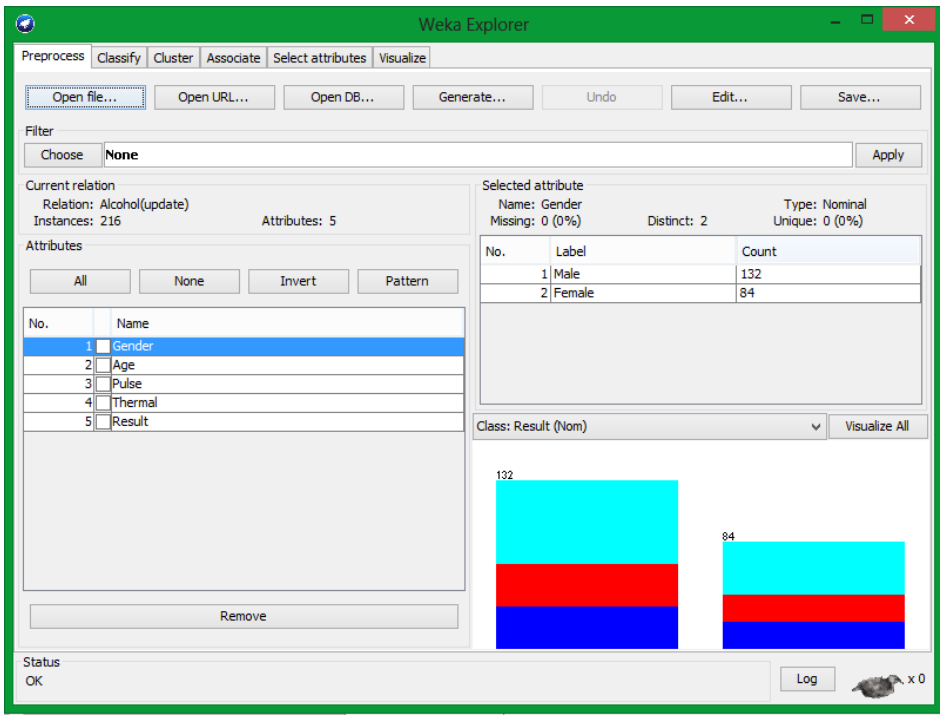

Figure 4.7 Weka classify group of result

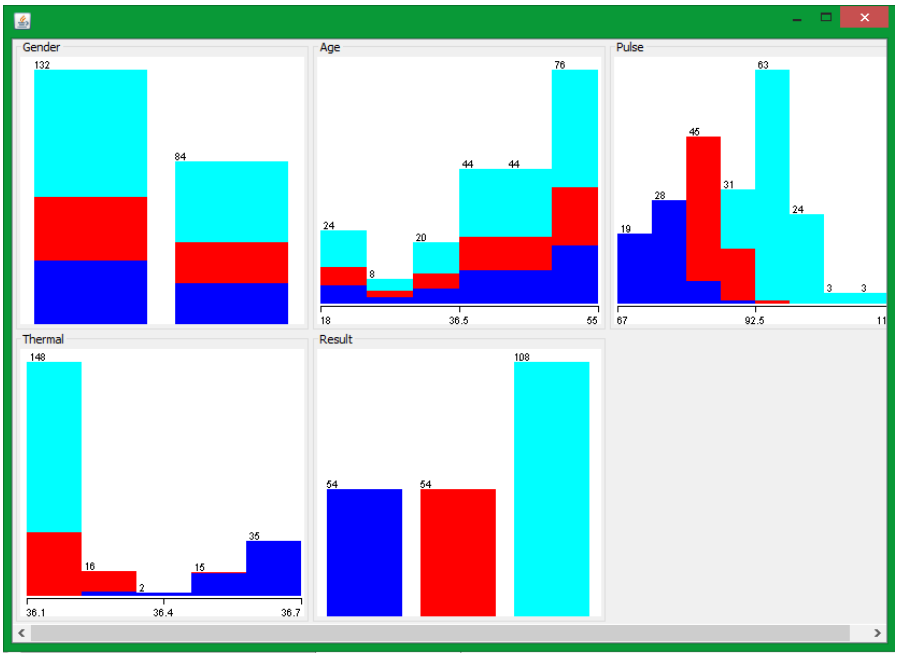

Figure 4.8 Classify compare data show in graphic

4.2.1.1 Generate rules.ZeroR show result as following.

=== Run information ===

Scheme:weka.classifiers.rules.ZeroR

Relation: Alcohol(update)

Instances: 216

Attributes: 5

Gender

Age

Pulse

Thermal

Result

Test mode:10-fold cross-validation

=== Classifier model (full training set) ===

ZeroR predicts class value: Drunk Lv.3 (More than 50)

Time taken to build model: 0 seconds

=== Stratified cross-validation ===

=== Summary ===

Correctly Classified Instances	108	50 %
Incorrectly Classified Instances	108	50 %
Kappa statistic	0	
Mean absolute error	0.4172	
Root mean squared error	0.4565	
Relative absolute error	100 %	
Root relative squared error	100 %	
Total Number of Instances	216	

=== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
0	0	0	0	0	0.473	Drunk Lv.1 (15-20)
0	0	0	0	0	0.465	Drunk Lv.2 (21-49)
1	1	0.5	1	0.667	0.485	Drunk Lv.3 (More than 50)
Weighted Avg.	0.5	0.5	0.25	0.5	0.333	0.477

=== Confusion Matrix ===

a	b	c	<-- classified as
0	0	54	a = Drunk Lv.1 (15-20)
0	0	54	b = Drunk Lv.2 (21-49)
0	0	108	c = Drunk Lv.3 (More than 50)

4.2.1.2 Generate rules.trees J48

=== Run information ===

Scheme:weka.classifiers.trees.J48 -C 0.25 -M 2

Relation: Alcohol(update)

Instances: 216

Attributes: 5

Gender

Age

Pulse

Thermal

Result

Test mode:10-fold cross-validation

=== Classifier model (full training set) ===

J48 pruned tree

Pulse <= 89

| Thermal <= 36.3

| | Pulse <= 79: Drunk Lv.1 (15-20 (2.0)

| | Pulse > 79

| | | Thermal <= 36.1

| | | | Pulse <= 88: Drunk Lv.2 (21-49 (3.0)

| | | | Pulse > 88: Drunk Lv.3 (More than 50 (2.0)

| | | Thermal > 36.1: Drunk Lv.2 (21-49 (49.0/1.0)

| Thermal > 36.3: Drunk Lv.1 (15-20 (51.0)

Pulse > 89: Drunk Lv.3 (More than 50 (109.0/3.0)

Number of Leaves : 6

Size of the tree : 11

Time taken to build model: 0.05 seconds

=== Stratified cross-validation ===

=== Summary ===

Correctly Classified Instances	204	94.4444 %
Incorrectly Classified Instances	12	5.5556 %
Kappa statistic	0.9108	
Mean absolute error	0.0463	
Root mean squared error	0.1907	
Relative absolute error	11.1065 %	
Root relative squared error	41.7771 %	
Total Number of Instances	216	

=== Detailed Accuracy By Class ===

TP Rate	FP Rate	Precision	Recall	F-Measure	ROC Area	Class
0.926	0.012	0.962	0.926	0.943	0.956	Drunk Lv.1 (15-20)
0.889	0.037	0.889	0.889	0.889	0.925	Drunk Lv.2 (21-49)
0.981	0.037	0.964	0.981	0.972	0.982	Drunk Lv.3 (More than 50)
Weighted Avg.	0.944	0.031	0.944	0.944	0.944	0.961

=== Confusion Matrix ===

```
  a   b   c   <-- classified as
 50   4   0 |   a = Drunk Lv.1 (15-20)
  2  48   4 |   b = Drunk Lv.2 (21-49)
  0   2 106 |   c = Drunk Lv.3 (More than 50)
```

4.2.2.3 J48 generate decision tree

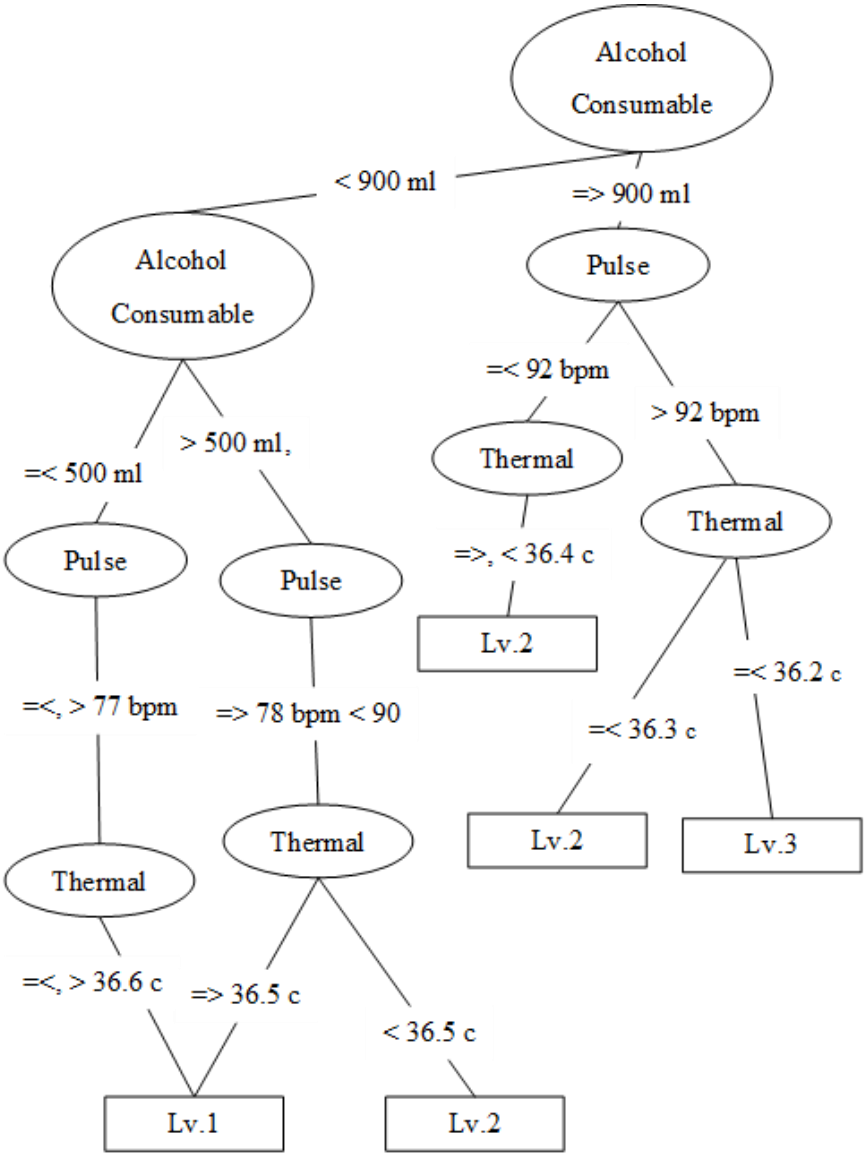

Figure 4.9 Deadlock system decision tree.

In Figure 4.7 alcohol level can be explained as follows

- Lv.1 = 15 – 20 mg% Not illegal allow start engine.
- Lv.2 = 21 – 49 mg% Not illegal allow start engine.
- Lv.3 = More than 50 mg% It is illegal not allow to start engine. (Faculty of Medicine. Siriraj Hospital.)

CHAPTER V
CONCLUSION AND DISCUSSION

"A Deadlock system for drunk driver using pulse detector combination with thermal detector" is and system created for drunk driver to decrease number of traffic accident. Researcher focuses on Infrared Pulse Detector and Thermal Detector to collect and analyst data.

This system contain as well 5 steps below.

- Cheap.
- Easy to fine spare part.
- Easy to use.
- Installation and testing, ""A Deadlock system for drunk driver using pulse detector combination with thermal detector" can set up on any type of automobile.
- When this system has done. It will be for prove test by the driver and evaluate satisfaction. The results told that, "A Deadlock system for drunk driver using pulse detector combination with thermal detector" system has stop engine when drunk driver who has over limit value. It performs as the good tool but the driver have to understand in technical recommendation.

Expect of result in this study.

- Reduce number of traffic accident in Thailand.
- Reduce cost of Alcohol Detector system.
- Reduce number of drunk driver.

5.1 Limitations

- A deadlock system for drunk driver decision making algorithm for value also covers for 4 cases.

- The correct system depends on references that the research inserts in Knowledge Base.

5.2 Problems

The problems appear in this research.

- While collecting data sometime pulse rate is not stable.
- When subjects are drink about 30 minute. Most subjects are not focus in research.
- Cannot collect data people under 18 year's old age because it is illegal.

5.3 Suggestions

- "A Deadlock system for drunk driver using pulse detector combination with thermal detector" although it available and answer the question to the purpose and framework. But it has some limit that the developer has to improve the following for more effective.
- Develop for expand or edit the Knowledge Base.
- Provide an international version or English language supported for who is interesting this application.

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APPENDIX

Appendix
Result of Classifier ruls.ZeroR in Weka

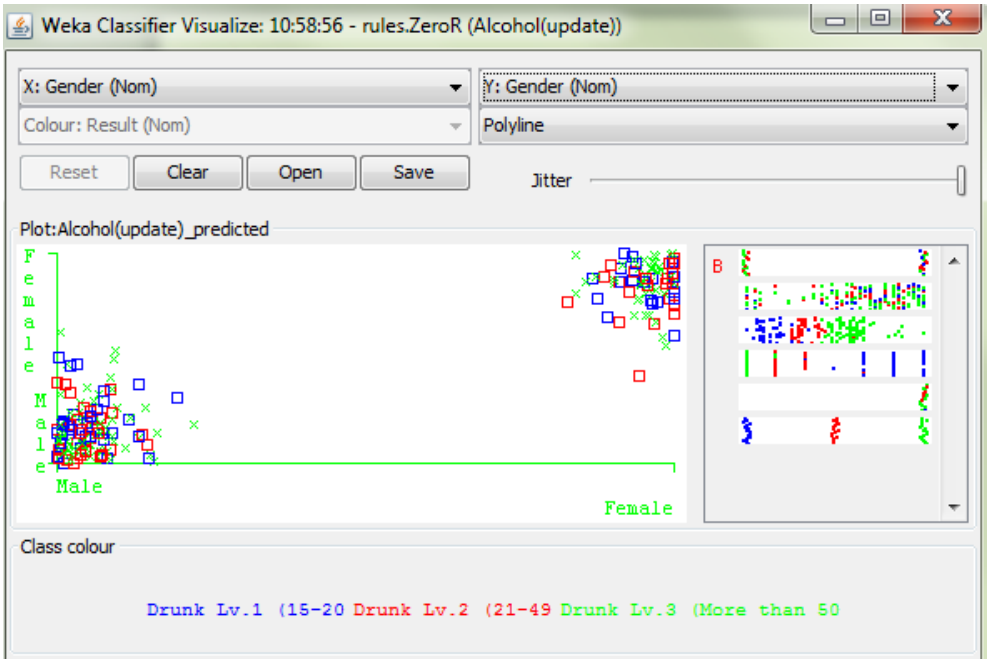

Figure 6.1 Gender errors classifier.

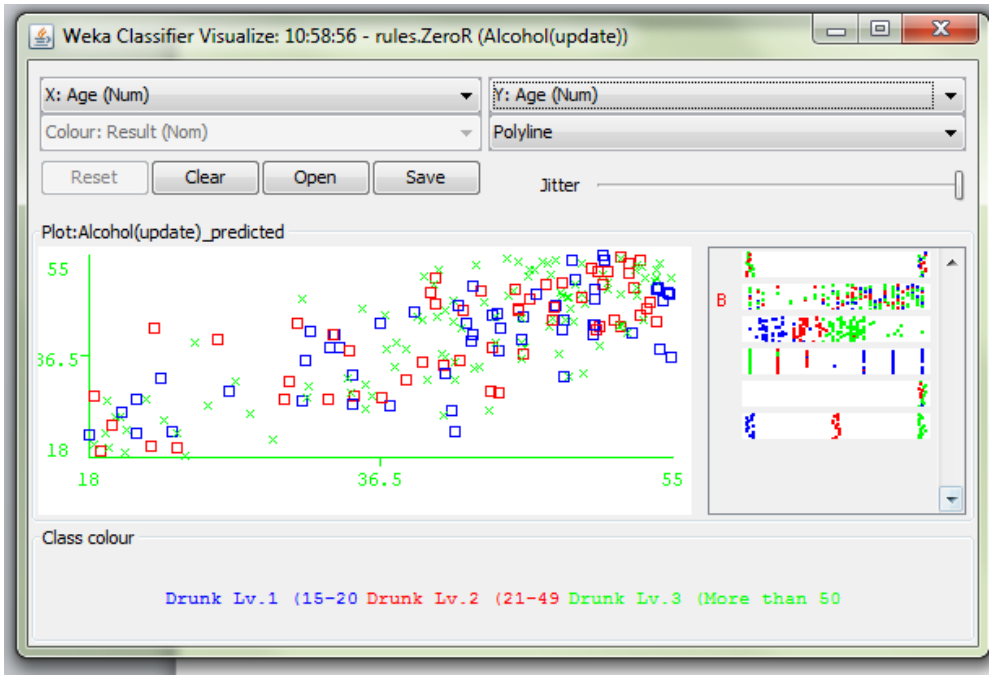

Figure 6.2 Age errors classifier.

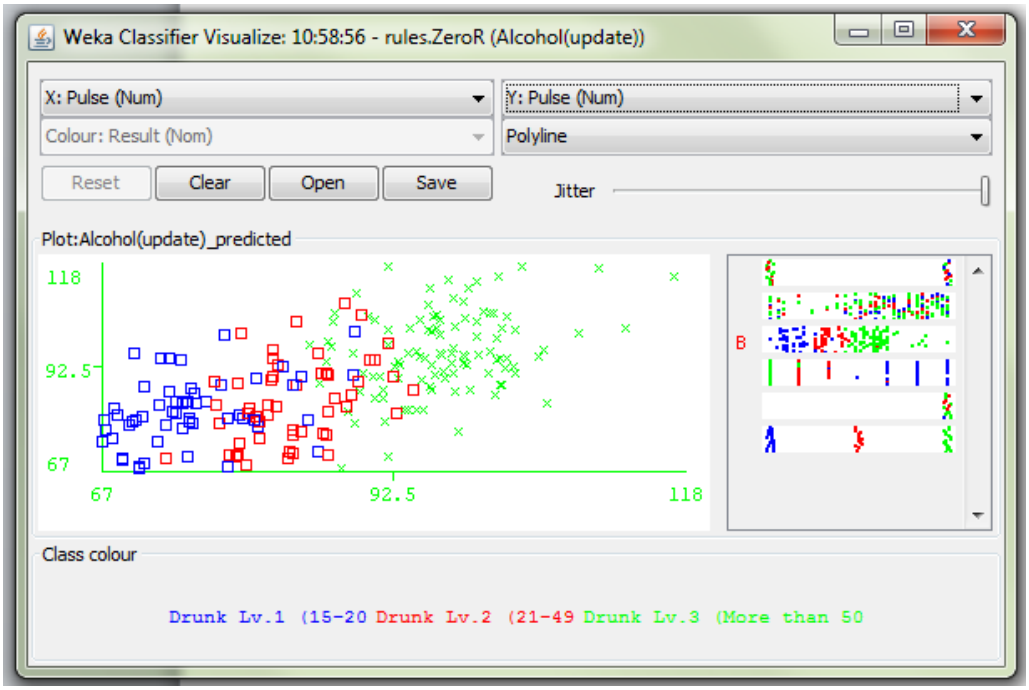

Figure 6.3 Pulse errors classifier.

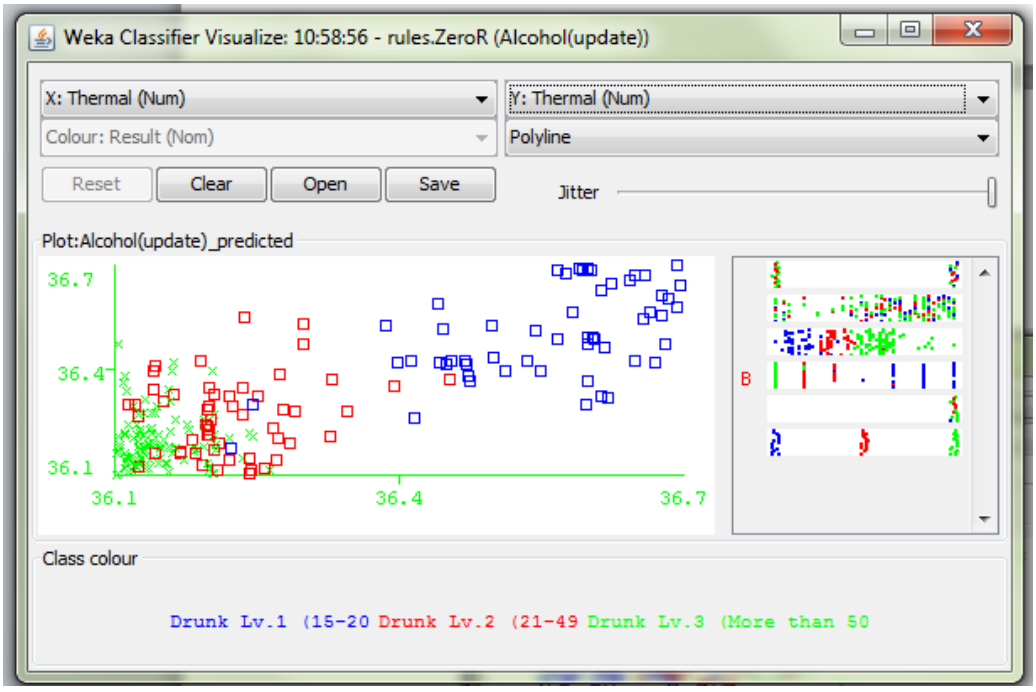

Figure 6.4 Thermal errors classifier.

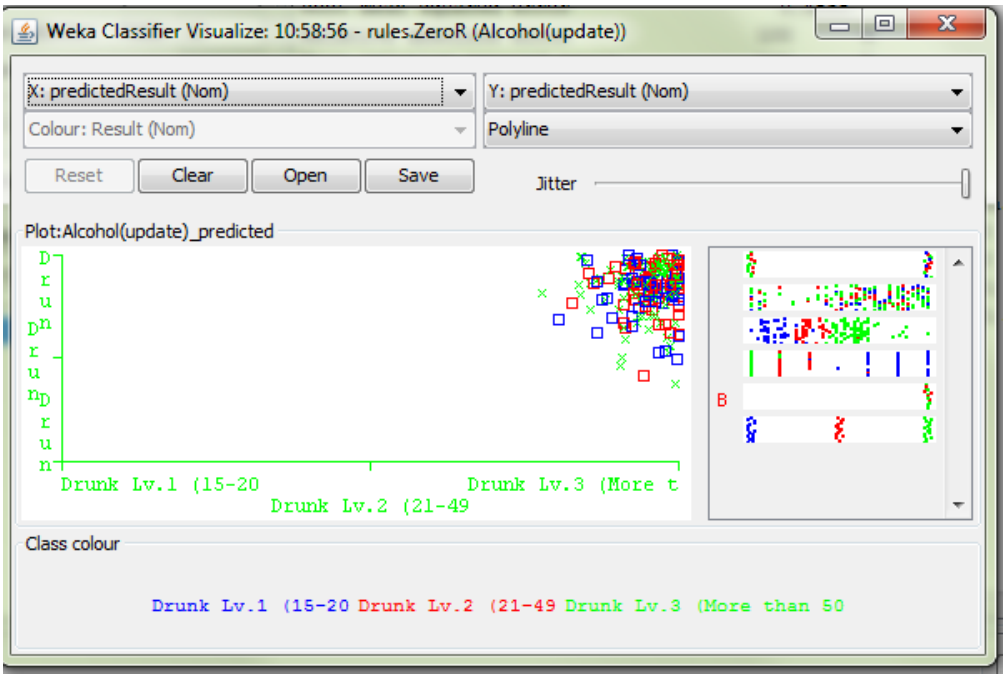

Figure 6.5 Predicted errors results.

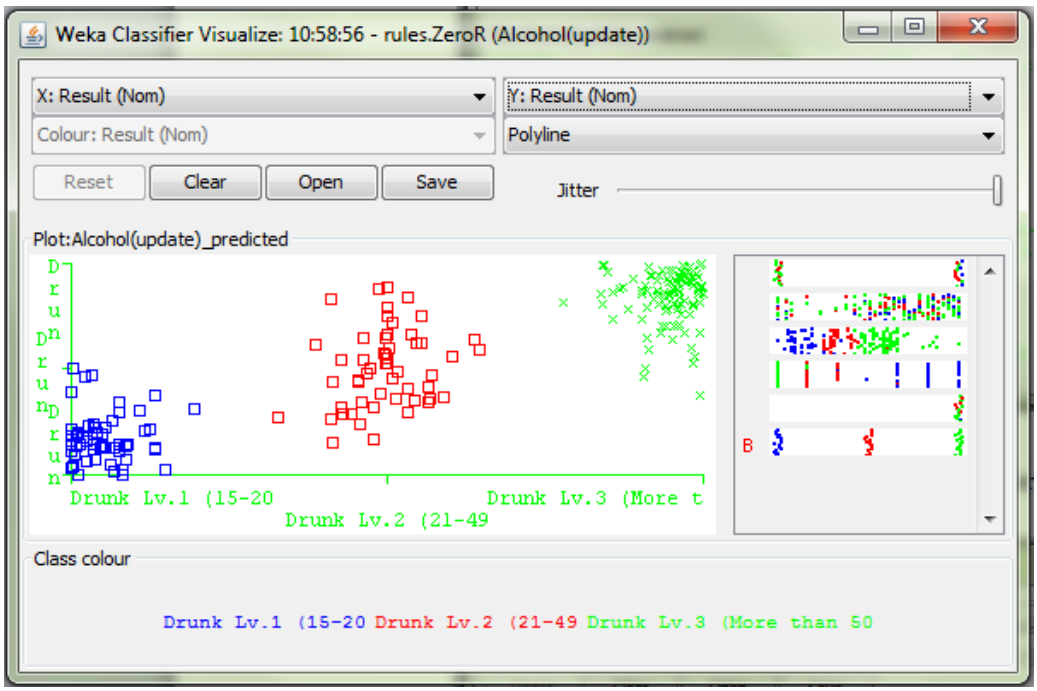

Figure 6.6 Results errors classifier.

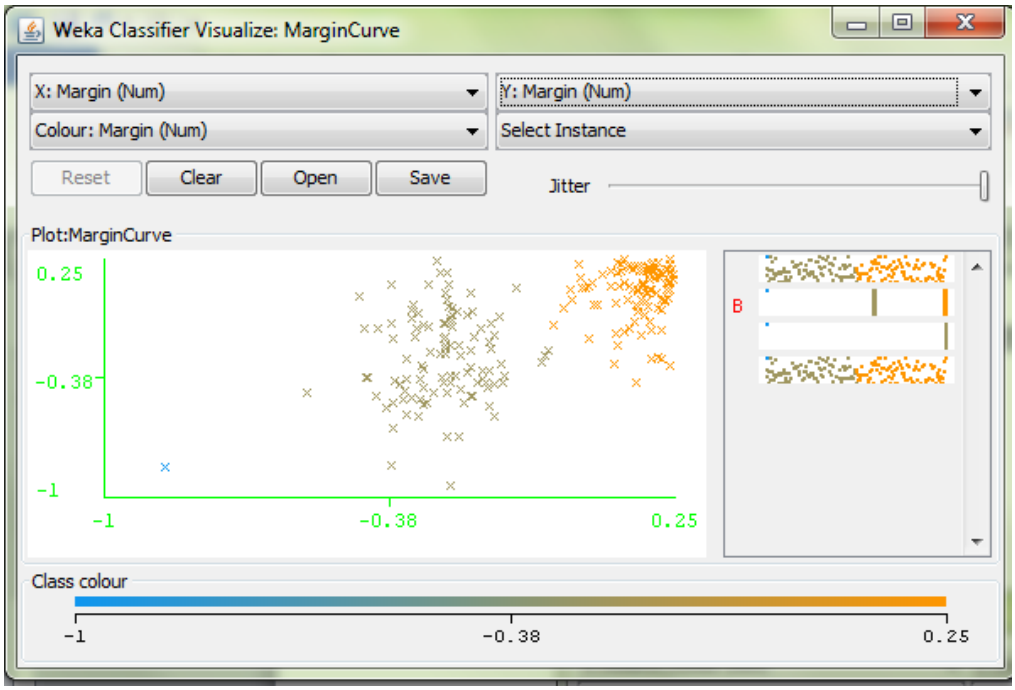

Figure 6.7 Instance number classifier curve.

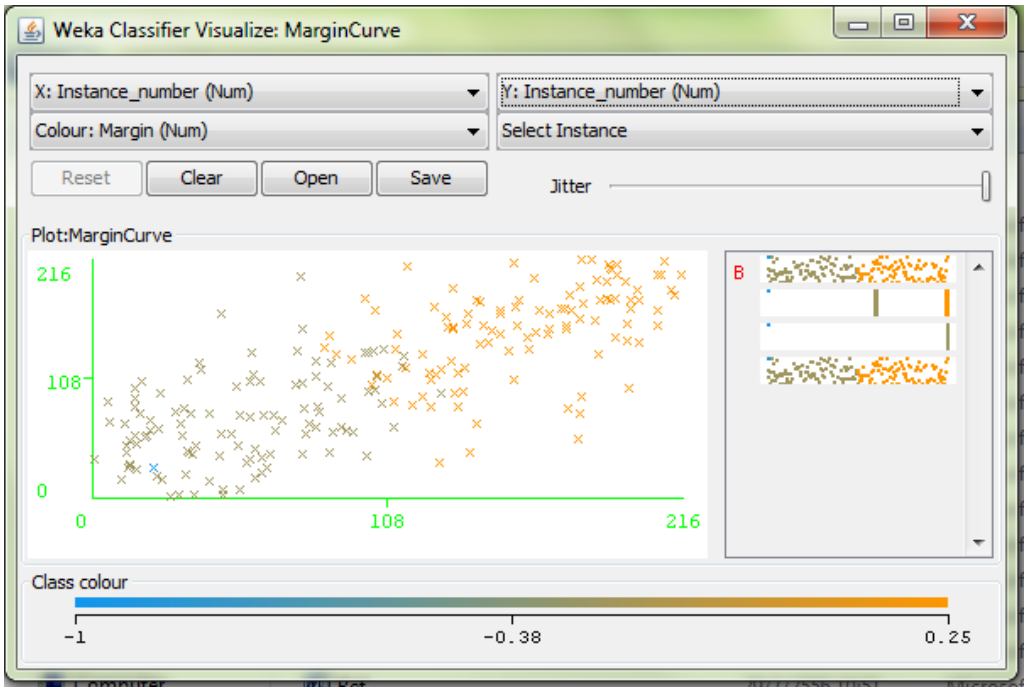

Figure 6.8 Margin classifier curve.

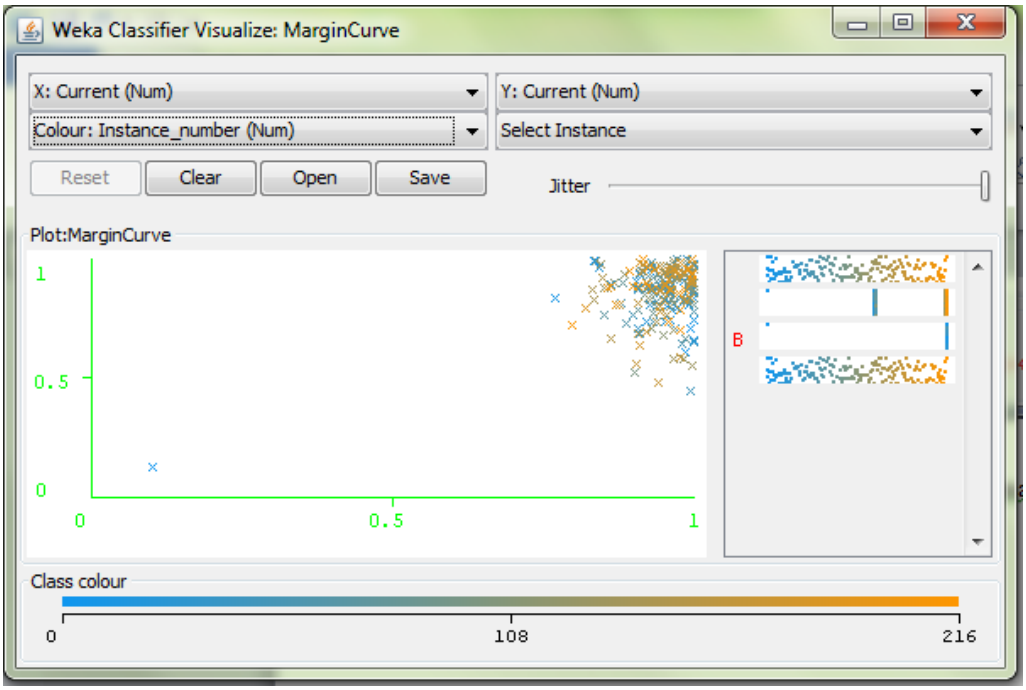

Figure 6.9 Current sample classifier curve.

Result of Classifier trees.J48R in Weka

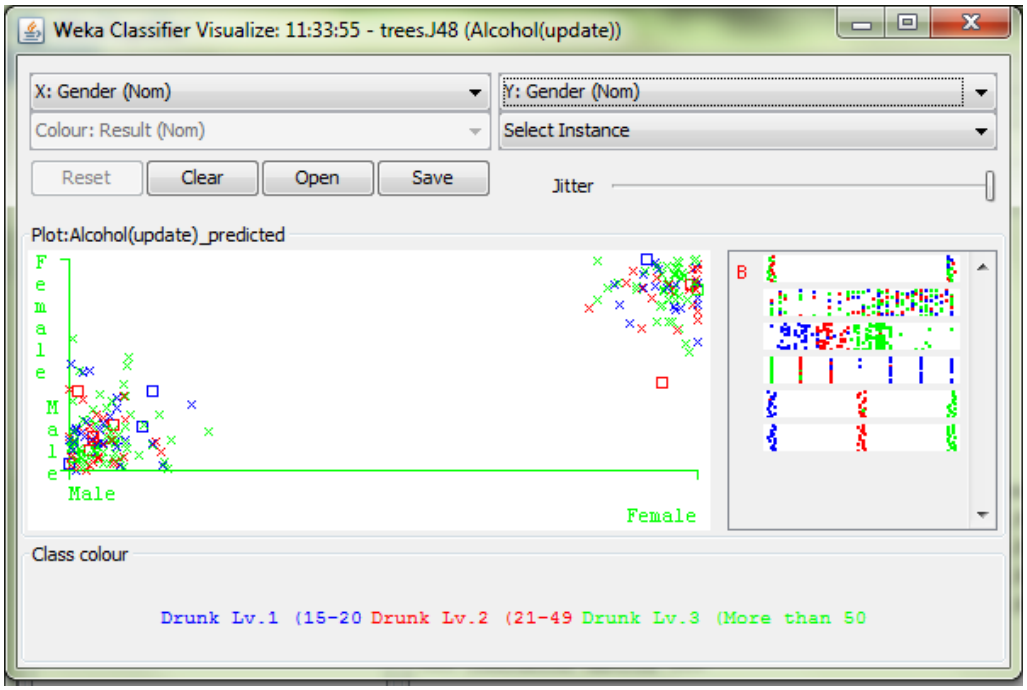

Figure 6.10 Gender classifier errors.

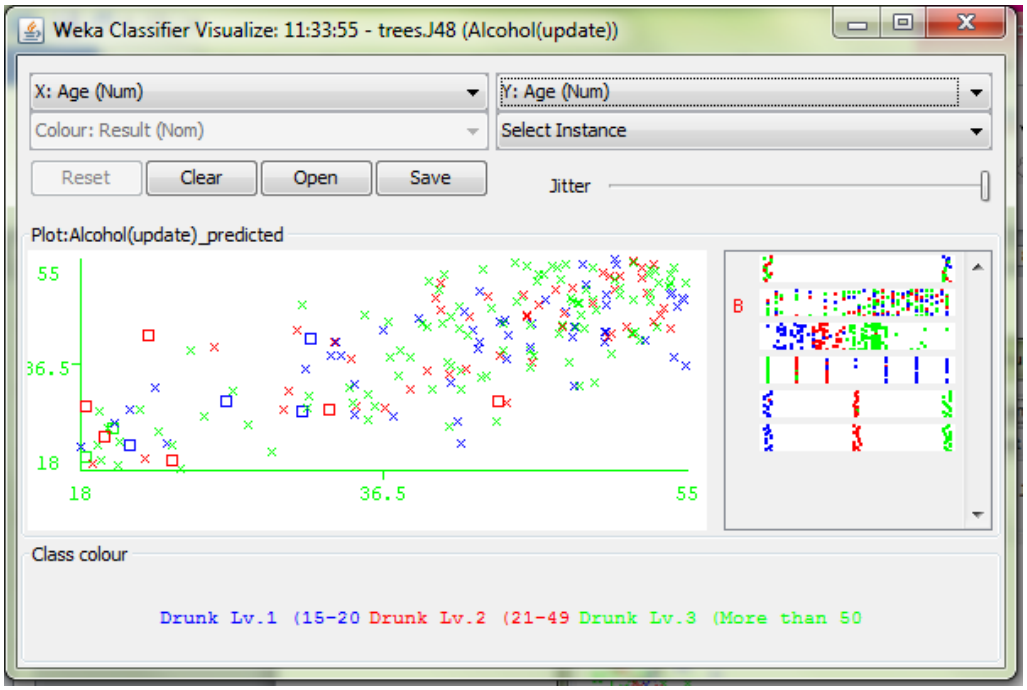

Figure 6.11 Age classifier errors.

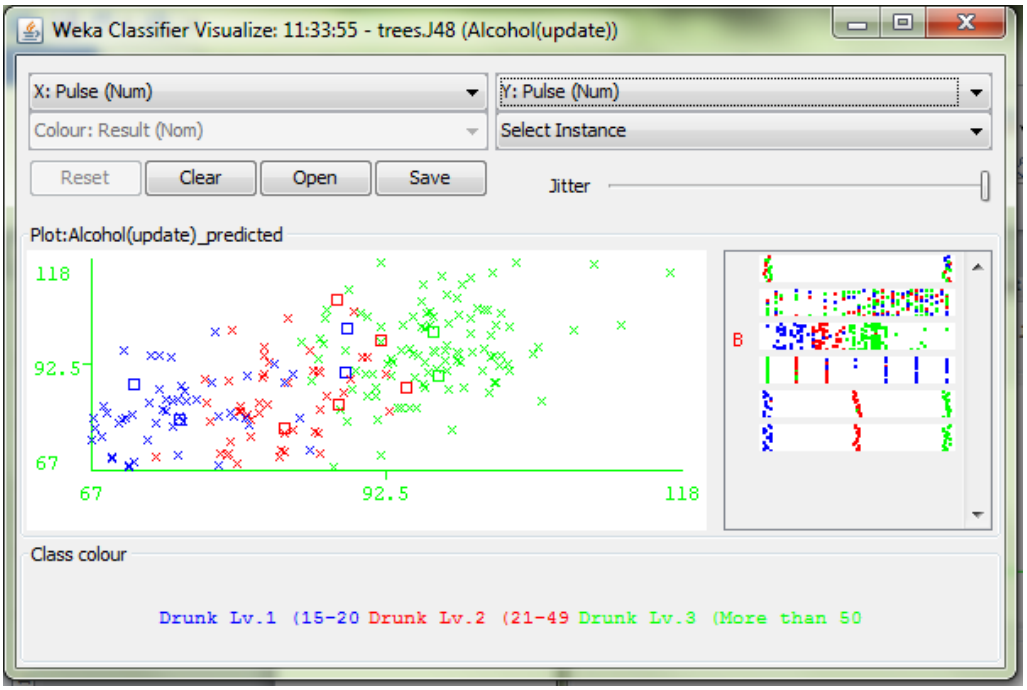

Figure 6.12 Pulse classifier errors.

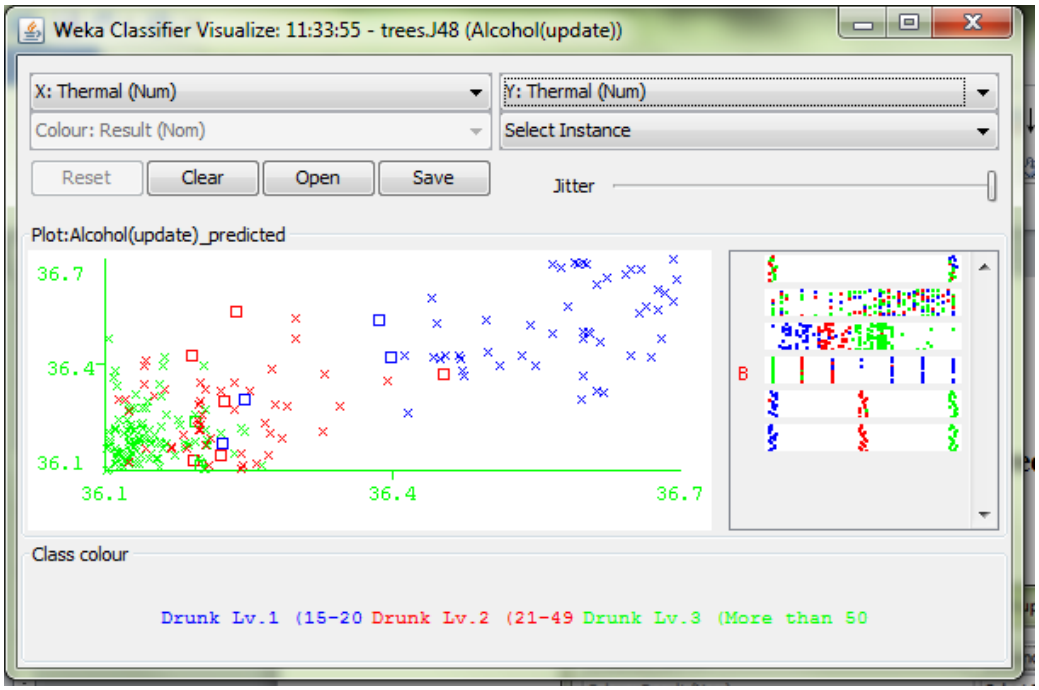

Figure 6.13 Thermal classifier errors.

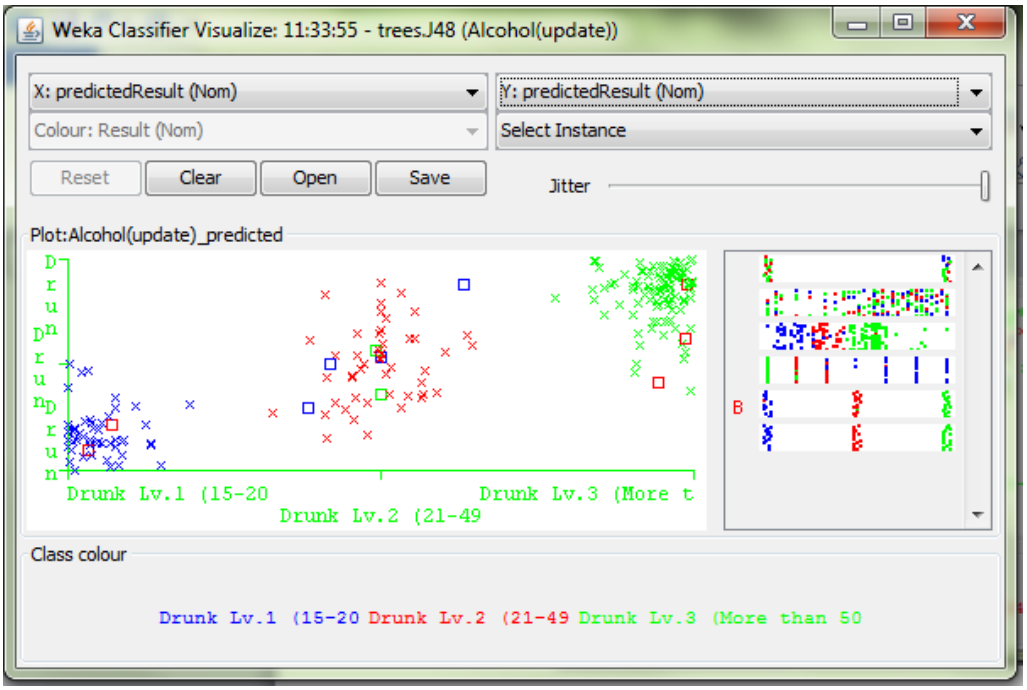

Figure 6.14 Predicted errors results.

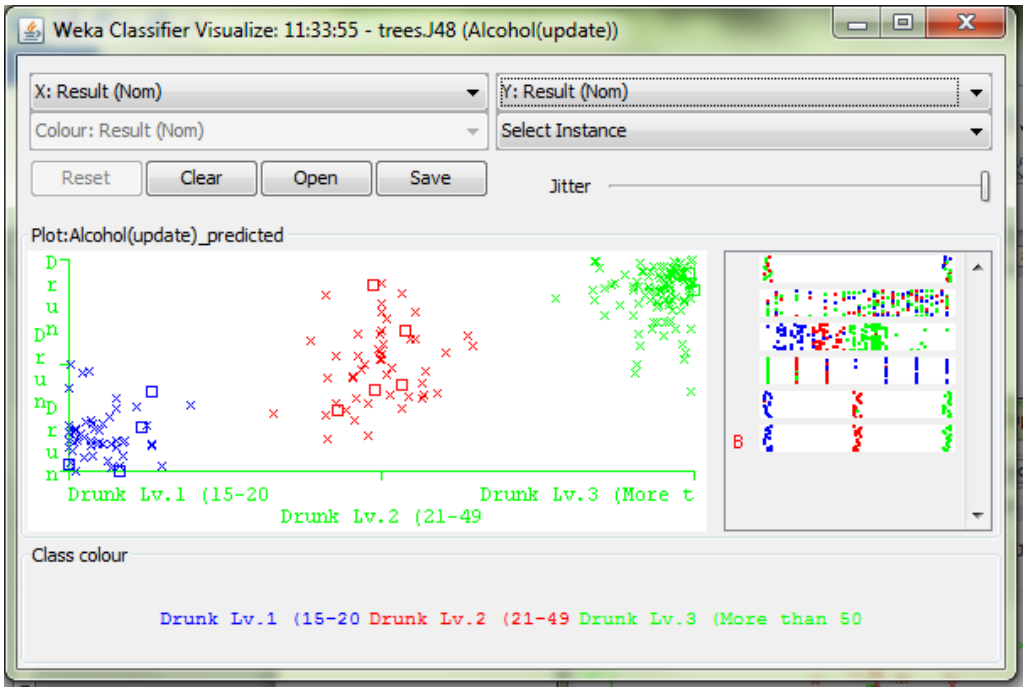

Figure 6.15 Results errors classifier.

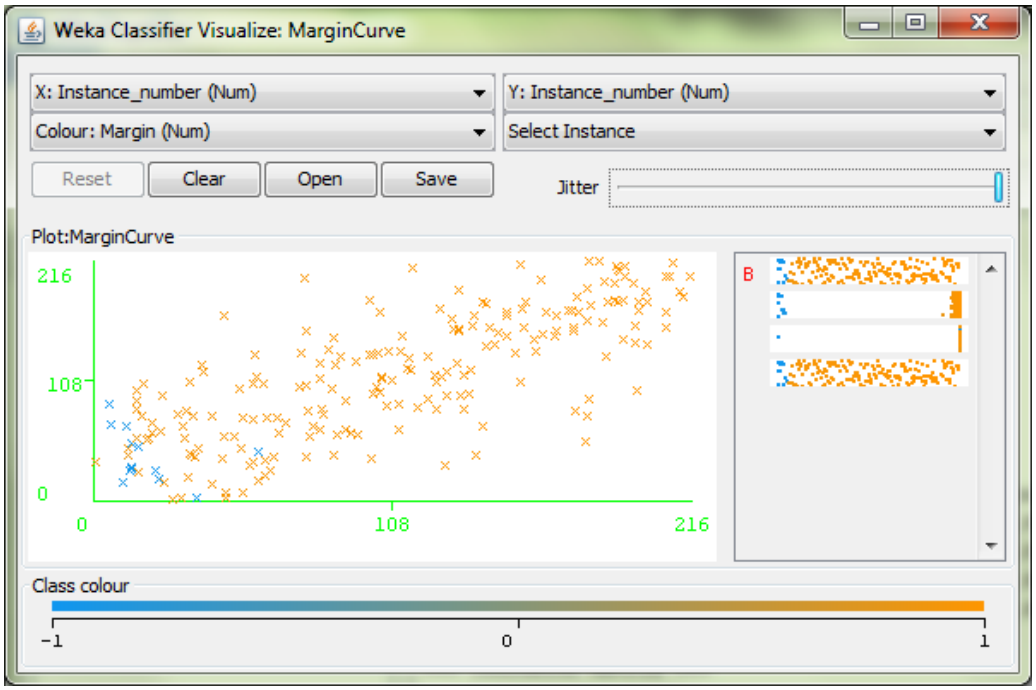

Figure 6.16 Instance number classifier curve.

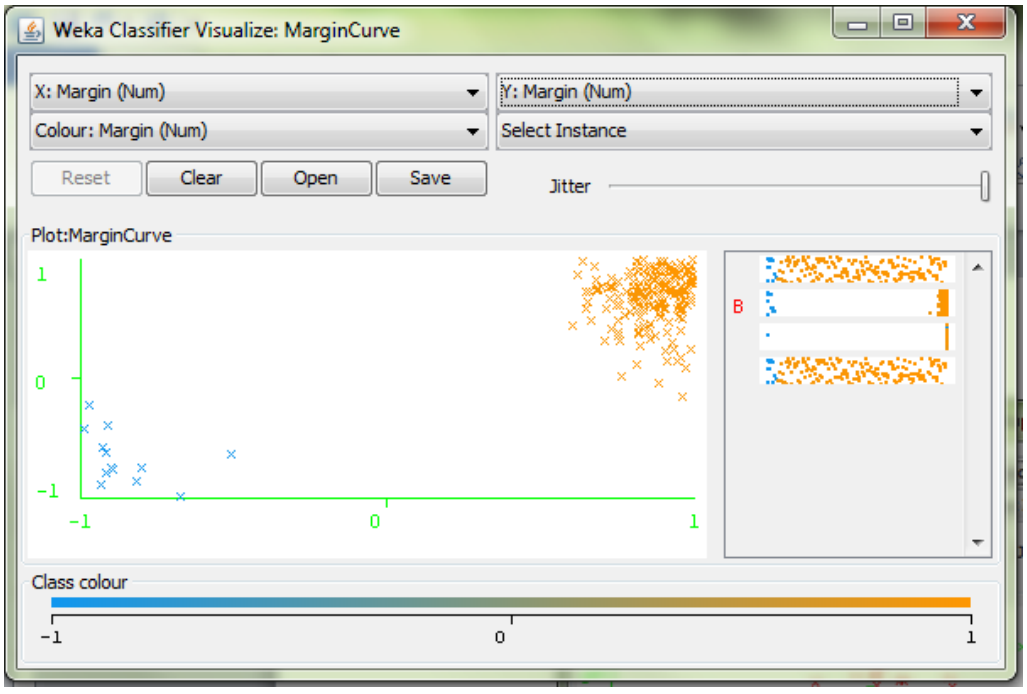

Figure 6.17 Margin classifier curve.

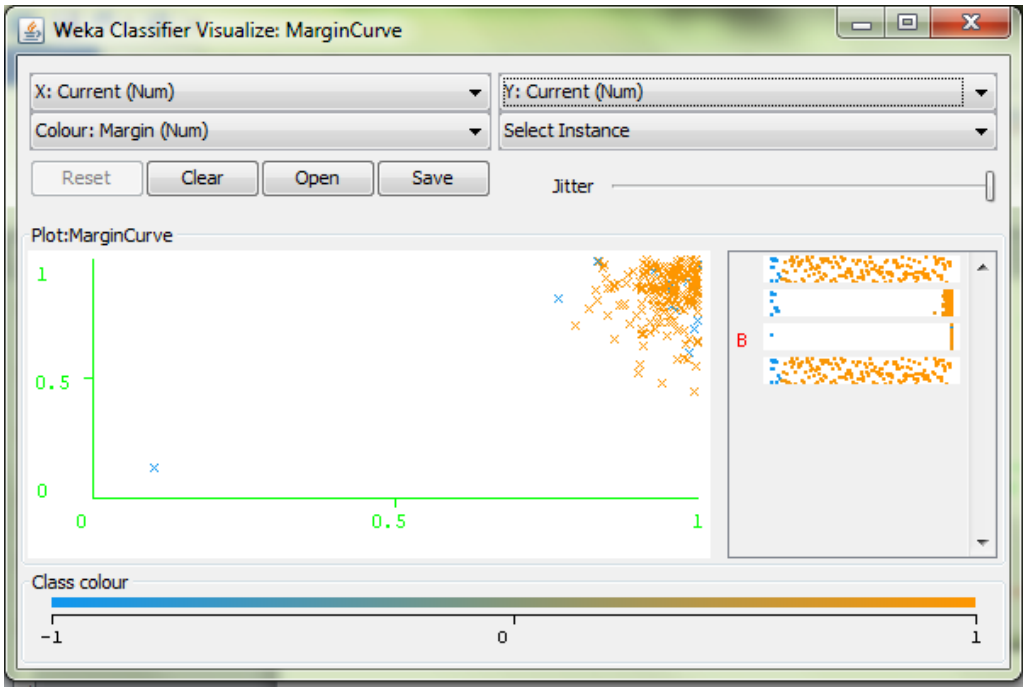

Figure 6.18 Current sample classifier curve.

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