# Test Anxiety Detection by Monitoring Changes in Skin Temperature and Pulse Rate with Data Logging Capability

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## ABSTRACT

This paper presents Test Anxiety Detection System using a Microcontroller, Temperature and Pulse Rate Sensors. The data are stored and analyzed in a computer via MATLAB program. Westside Test Anxiety Scale was used to verify the level of anxiety of the 21 respondents. The results showed that 62% of the respondents have average anxiety, 43% of the respondents have a faster pulse rate and 52% has lower skin temperature than the normal. The system can therefore be used in determining Test Anxiety and other types of Anxiety.

## KEYWORDS

Test Anxiety, Microcontroller System, Pulse Rate, Skin Temperature, Westside Scale Anxiety

## 1 INTRODUCTION

### 1.1 Background of the Study

Anxiety is a physical response of an individual from the environment. This is crucial for humans and animals to survive. It starts as a biochemical change in the brain and body with the release of adrenaline from the adrenal glands. This hormone increases pulse rate as well as anxiety. The function of the sympathetic system leads to anxiety which causes the body to prepare for "fight or flight" responses. [1]

Studies showed that the fight or flight responses of the body leads to the increase in pulse rate, and blood pressure, constriction of vessels of the skin, dilation of pupil of the eye, increase activity in reticular formation of the brain, contraction of muscles, etc. [3]

Anxiety has many forms and one of those is test anxiety. It is characterized when an individual experiences stress and discomfort before or during the examination. This response affects an individual's ability to perform well resulting to negative effects on social, emotional, and behavioral aspects in daily functioning. [1]

Several studies have shown that test anxiety may lower student's performance in up to 10% of the school-aged population. Thus, nowadays this has become a pervasive problem in the contemporary society. It may affect someone's performance in aptitude and achievement test scores which are very essential especially if a person is enrolling for college or applying for a job. However, this is a treatable condition. [2]

Test anxiety is a treatable condition but assessing and evaluating it is a problem in the society. Aptitude and achievements test scores are increasingly used in evaluating individuals for hiring and school admission. [2]

### 1.2 Related Studies

Subjects with high test anxiety showed greater pulse rate increase in response to an anagram solving task than did subjects with low anxiety. Highly anxious subjects showed greater and longer periods of pulse rate acceleration and less deceleration than the low-anxious subjects

during a problem solving task under evaluative stress conditions. [4]

Nonlinear HRV analysis using short term ECG recording could be effective in automatically detecting real-life stress condition, such as a university examination. [5] Experimental results show that Personalized Stress Detection from Physiological Measurements electrocardiogram, electromyogram, skin conductance, and respiration can detect stress with high precision. [6]

Physiological data collected and analyzed during real world driving tasks to determine a driver's relative stress continuous physiological features were correlated with a continuous metric of observable stressors showing that on a real-time basis metrics of skin conductivity and pulse rate were most closely correlated with driver stress. [7]

A computer-based "Paced Stroop Test" was designed to act as a stimulus to elicit emotional stress in the subject using four signals: Blood Volume Pulse (BVP), Galvanic Skin Response (GSR), Pupil Diameter (PD) and Skin Temperature (ST). [8]

## 1.3 Gap and Missing Information

Previous studies were conducted only through the use of test anxiety questionnaires to determine the level of the test anxiety of the respondents. Other studies used electronic devices to measure either temperature or pulse rate in determining the level of stress in general.

## 1.4 Objectives of the Study

The main objective of the study is to design an electronic device using temperature and pulse rate sensors with data logging capability in distinguishing the relationship of the temperature and pulse rate in test anxiety.

Specifically, the research aimed at:
1. Developing electronic device that measures skin temperature and pulse rate.
2. Creating a user interface in data logging.
3. Determining the level of test anxiety of the respondents using the Westside Test Anxiety Scale.
4. Testing and gathering skin temperature and pulse rate of the respondents with different level of test anxiety depending on the Westside Test Anxiety Scale.
5. Verifying the data gathered and its relationship with test anxiety.

## 1.5 Significance of the Study

This study is beneficial in increasing the awareness of the Engineering students in the university regarding what test anxiety is and serve as an aid in alleviating test anxiety among test takers.

The study is useful to counselors, psychologists and other institutions in increasing their awareness regarding the percentage of test anxious individuals in the community or other educational institutions which can lead them to implement intervention programs. Test anxiety awareness can contribute to the improvement of the performance of students of the College of Engineering and can possibly help to increase their scores in their examinations.

## 1.6 Scope and Delimitation

The respondents involved in the study were Engineering students of the university. The study limited the measurement to skin temperature and pulse rate. Twenty-one (21) students with different levels of test anxiety were tested and observed their physiological changes.
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Engineering students were targeted as samples since their academic subjects focus more on the

mathematical analysis and critical thinking which lead to higher test anxiety. Individuals who were high on math anxiety also tend to score high on other anxiety tests. [9] The test and verification were conducted before major examinations in Mathematics, GEAS (General Engineering and Applied Science) subjects and Practical Examination. Minor factors such as respondents' gender, disability, mental/physical health and other psychological impairment aside from test anxiety such as depression are delimited from the study.

## 2  METHODOLOGY

The researchers randomly selected 21 respondents using purposive sampling. The respondents answered Westside Test Anxiety Scale (WTAS) which measures the level of their test anxiety. The WTAS was administered before the respondents' examination. The data gathered were stored and logged in a computer. The data gathered was analyzed and the device indicated the level of respondents' test anxiety.
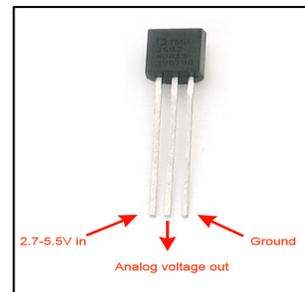
### 2.1  Preparation of Materials
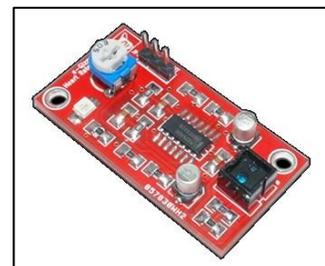


**Figure 1.** ACEduino 328



**Figure 2.** The LM35



**Figure 3.** Pulse Rate Sensor



**Figure 4.** Light Emitting Diode



**Figure 5.** Casing

**Figure 6.** Schematic Diagram

## 2.2 Sensors and ACEduino

LM35 Temperature Sensor was used in the study. The E-Gizmo Pulse Rate Monitor Kit is used in the study to obtain real time data. ACEduino IDE is used as the microcontroller in the system. The E-Gizmo Pulse Rate Monitor Kit and ACEduino IDE are available only in the Philippines.

## 2.3 Creating the User Interface Using Microsoft Excel and MATLAB

A user interface was created using MATLAB for data logging and data plotting.

## 2.4 Purposive Sampling

Using purposive sampling, the respondents were selected. The students of the College of Engineering in University of Perpetual Help System DALTA – Las Pinas Campus were chosen as the samples since engineering subjects are all about calculations, critical thinking, and logic which may contribute to increasing the anxiety of the students before or during the examination.

## 2.5 Quantitative Research Method Using Westside Test Anxiety Scale

The ten-item Westside Test Anxiety Scale was used to determine the test anxiety of the respondents. This scale was developed and by Richard Driscoll (2004). The data collected was verified by the system developed.

## 2.6 Measuring Parameters using Test Anxiety Detector

The Test Anxiety Detector will log the change of temperature and pulse rate of the respondents before the examination. Students who have high level of test anxiety level were forecasted to lower the temperature in their extremities and an increase rate of change in the pulse rates.



**Figure 7.** Conceptual Framework
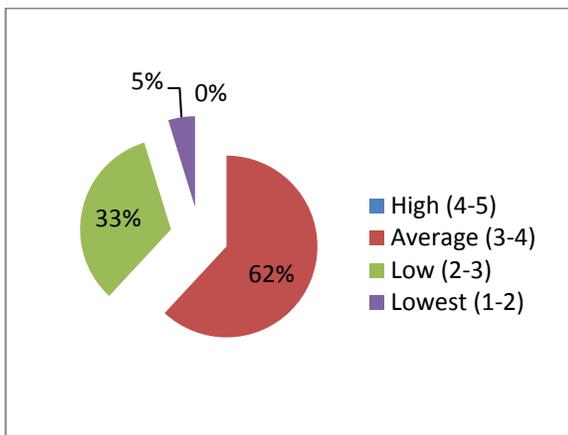
## 3  RESULTS AND DISCUSSION



**Figure 8.** Test Anxiety Level of the Respondents According to Westside Test Anxiety Scale

Computer Fundamental subject is an interesting subject that uses logics and critical thinking in creating source codes in C++ language. With these, students are expected to get anxious in practical exams. The data gathered from the Westside Test Anxiety Scale showed the following results: Sixty-two percent (62%) of the respondents have an average level in test anxiety, thirty-three percent (33%) of the respondents have a low level in test anxiety and Five percent (5%) of the respondents have the lowest level of test anxiety but no one from the class had a high level of test anxiety.
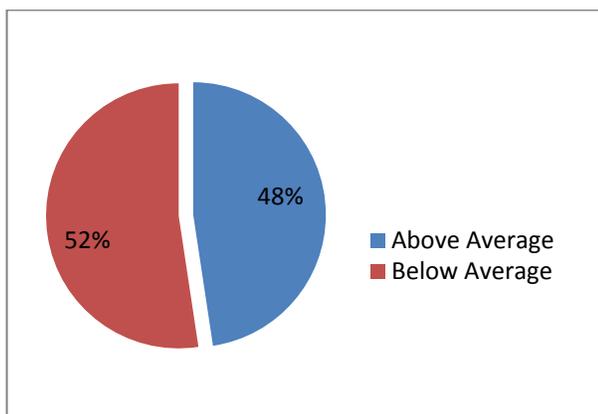


**Figure 9.** Respondents' Skin Temperature before Examination

**Table 1.** Respondents' Temperature

| RESPONDENT | TEMPERATURE |
|---|---|
| | °C |
| 1 | 34.5 |
| 2 | 33.7 |
| 3 | 33.8 |
| 4 | 33.4 |
| 5 | 34.3 |
| 6 | 35.1 |
| 7 | 34.3 |
| 8 | 34.7 |
| 9 | 33.8 |
| 10 | 34.8 |
| 11 | 34.6 |
| 12 | 33.0 |
| 13 | 33.3 |
| 14 | 33.2 |
| 15 | 34.0 |
| 16 | 33.5 |
| 17 | 32.7 |
| 18 | 34.5 |
| 19 | 34.2 |
| 20 | 32.8 |
| 21 | 33.2 |
| AVE | 33.9 |

The normal body temperature of the body is about 36 °C to 37 °C but the extremities such as hands and feet are quite colder than body temperature. Table 1 shows that the average temperature of respondents' extremities is 33.9°C. Forty-eight percent (48%) of the respondents have above average temperature but the remaining fifty-two percent (52%) has a lower skin temperature than the average temperature.
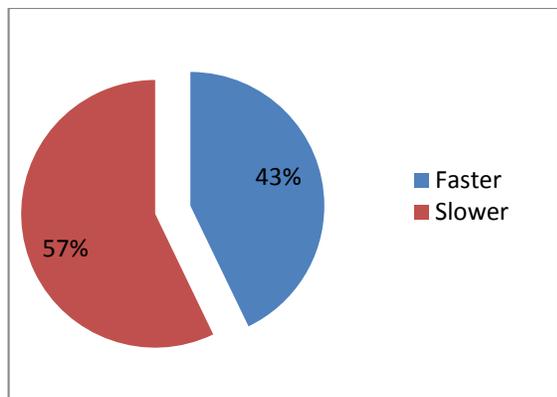
**Figure 10.** Respondents' Pulse Rate before Examination

**Table 2.** Respondents' Pulse Rate

| RESPONDENT | PULSE RATE bpm |
|:---:|:---:|
| 1 | 112 |
| 2 | 75 |
| 3 | 94 |
| 4 | 93 |
| 5 | 73 |
| 6 | 80 |
| 7 | 85 |
| 8 | 84 |
| 9 | 98 |
| 10 | 74 |
| 11 | 80 |
| 12 | 75 |
| 13 | 110 |
| 14 | 85 |
| 15 | 69 |
| 16 | 73 |
| 17 | 79 |
| 18 | 66 |
| 19 | 71 |
| 20 | 104 |
| 21 | 87 |
| AVE | 87 |

The normal pulse rate of a millennial student is range from 60bpm from an ordinary students and 100bpm from an athletic. Table 2 shows that the average pulse rate of the students is 87 bpm; forty-three percent (43%) of the students have a faster pulse rate than the average while the remaining fifty-seven percent (57%) have a slower pulse rate than the average.

## 4  CONCLUSIONS

The Test Anxiety Detection System developed monitors skin temperature and pulse rate of the respondents. Logging capability of the device using MATLAB helps the user to monitor the test anxiety level of the students.

Skin temperature was lower among respondents before taking the examination. The heat from their extremities loses; the pulse rate of the students became faster from 60 bpm as the mental pressure they carry before the examination. These results did not contradict with the Westside Test Anxiety Scale.

## 5  RECOMMENDATIONS

The researchers recommend to the future researchers to find other "fight or flight" responses that can be measured to further develop the system in detecting test anxiety. The next researchers can also use wireless technologies such as mobile applications that can monitor the parameters smoothly. Alert system notification such as GSM can be used that is capable to alert a person when the measurement of the parameters is deviating from the normal which might result to test anxiety. Other technologies such as Zigbee can also be used.

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