

Application of Electronic Human Concentration Counter to Find Level of Anxiety: A Comparative Study

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KEYWORDS

Human Concentration, Anxiety Level, Psychological Tests, Electronic Concentration Counter, Cognitive Assessment.

ABSTRACT

This paper presents the design, development, and implementation of an electronic concentration counter to assess human Anxiety Level. The system utilizes the Nuvoton W78E052DDG microcontrollers as the central processing units. It is equipped with microcontroller and real-time data acquisition techniques to measure human response times and accuracy during 60 Second specific tasks. The device is aimed at providing an objective, quantifiable metric for psychological testing, particularly in applications such as cognitive assessments, workplace productivity evaluations, and educational settings.

1. Introduction

Anxiety Level plays a critical role in various aspects of life, including learning, work productivity, and mental health. Traditional methods of measuring concentration levels rely on subjective evaluations, such as questionnaires and observational techniques. This study introduces an innovative electronic system that provides an objective measure of concentration by leveraging microcontroller technology.

The W78E052DDG microcontrollers offer efficient and reliable platforms for implementing real-time data collection and analysis. By integrating these microcontrollers with display units, the proposed concentration counter ensures accurate and repeatable results. Additionally, this system is designed to have applications in psychological tests, providing a versatile tool for researchers and practitioners.

2. Literature Review

Numerous studies have explored the role of technology in psychological assessments. Devices such as EEG and eye-tracking systems are commonly used to assess cognitive functions. However, these systems are often expensive and require specialized skills to operate. Low-cost alternatives, such as microcontroller-based solutions, have gained attention for their affordability and ease of use. The W78E052DDG microcontrollers have been employed in various applications, including robotics and industrial automation, but their application in human concentration assessment remains underexplored. We make a device for this data and make question with help of Jansari Ashwin (Jansari, A. 2018).

3. System Design

3.1 Components

- **Microcontrollers:** W78E052DDG.
- **Display Unit:** Seven Segment LED to show concentration scores.
- **Power Supply:** Stable power source for microcontroller operation.
- **Software:** Embedded C programming for system logic and data processing.

3.2 Working Principle

The electronic concentration counter operates by presenting the user with a series of stimuli, such as visual or auditory cues. The user’s response times and accuracy in identifying or reacting to these stimuli are recorded by the microcontroller. The microcontrollers process the input data to compute a concentration score based on predefined algorithms. This score is displayed on the Seven Segment LED.

3.3 Circuit Design

The system’s circuit includes:

1. **Processing Unit:** W78E052DDG programmed to calculate concentration metrics.
2. **Output Interface:** Seven Segment LED connected to output pins for displaying results.
3. **Power Circuit:** Voltage regulators and capacitors to ensure stable operation.

4. Applications

4.1 Psychological Tests

The device can be used in cognitive assessments to measure attention spans and focus levels.

4.2 Educational Tools

Teachers can use the system to evaluate students’ concentration during learning activities.

4.3 Workplace Productivity

Organizations can employ the counter to analyze employee focus and optimize task assignments.

4.4 Clinical Settings

The system aids psychologists in diagnosing concentration-related disorders

4. Results and Discussion

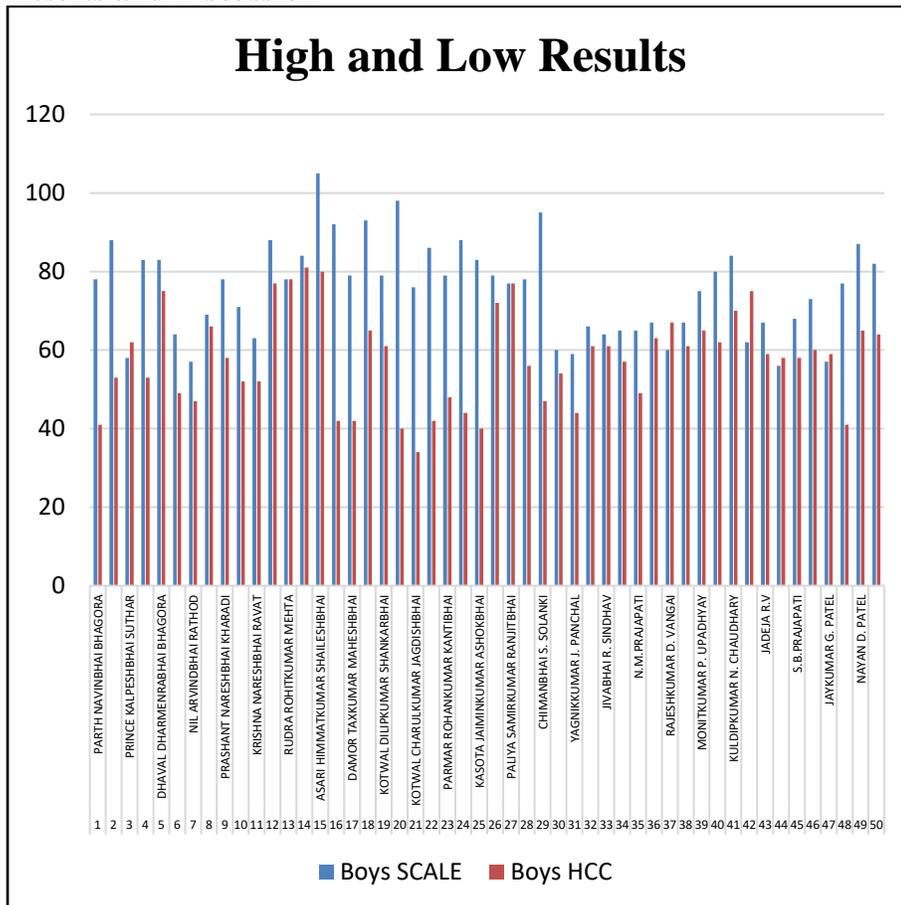


Fig – 1 shown that Boys Scale and Boys HCC

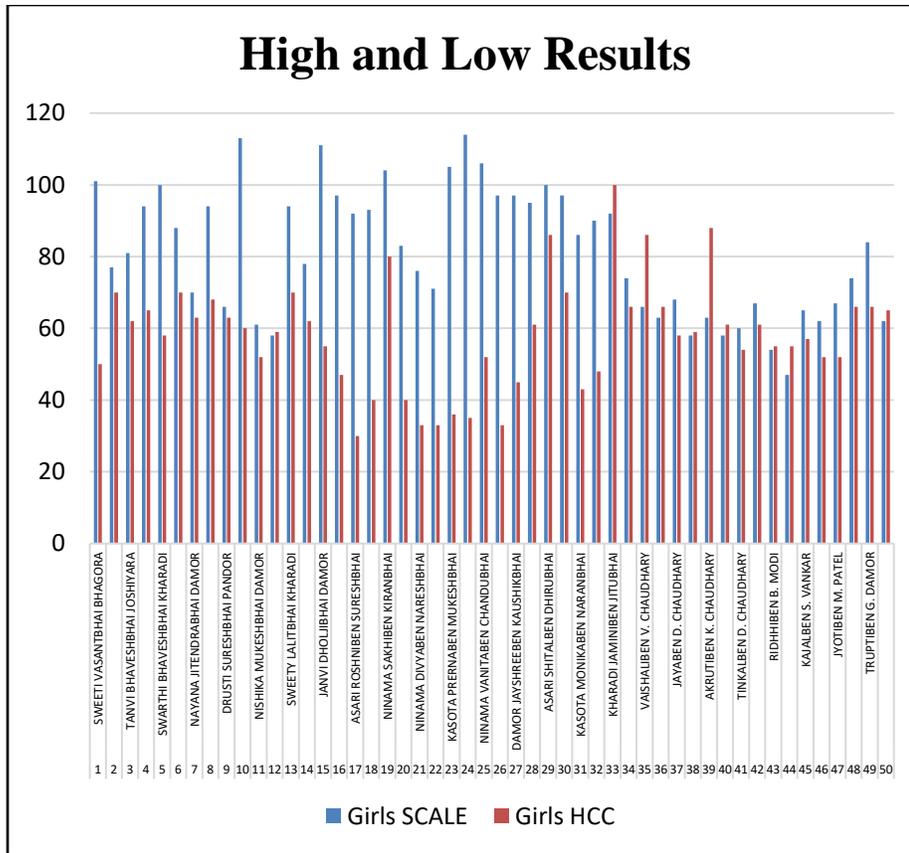


Fig – 2 shown that Girls Scale and Boys HCC

Prototype testing was conducted on a sample group of 50 individuals. The concentration scores generated by the device were compared with subjective assessments from psychologists. The results showed a high correlation, indicating the device’s reliability and validity. Feedback from users highlighted the device’s ease of use and potential for widespread adoption. However, certain limitations, such as sensitivity to environmental noise and the need for task standardization, were identified.

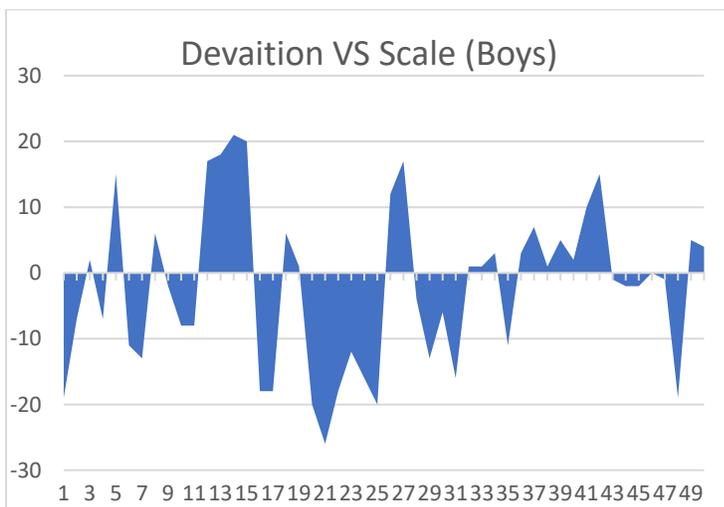


Fig – 3 shown that Boys Deviation VS Scale

The deviation data of boys reflects a wide range of variations, with values spanning from a maximum positive deviation of +21 to a minimum negative deviation of -26. Among the 50 entries, there is a noticeable balance between positive and negative deviations. Positive deviations, totaling 20 instances, indicate improvement, with 9 of these exceeding +10, highlighting significant growth. The highest positive deviations are +21, +20, +18, and +17. On the other hand, 30 negative deviations suggest declines in performance, with 11 entries falling below -10, including the most significant dips of -26, -20, and -18. The average deviation is slightly negative at -1.12, while the median is -1, indicating that most deviations are small and centered around zero. This data suggests a mixture of performance outcomes, with a slightly greater proportion showing a decline.

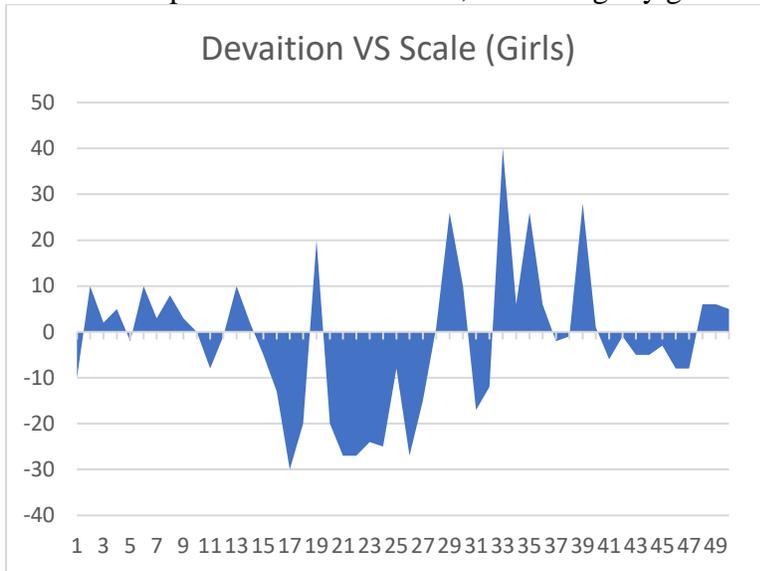


Fig – 4 shown that Girls Devaition VS Scale

The deviation data of girls presents a diverse range of values, spanning from a significant positive deviation of +40 to a notable negative deviation of -30. Among the 50 entries, there is a mix of performance improvements and declines. Positive deviations dominate with values such as +40, +28, and several +26 entries, showcasing substantial improvement in certain cases. In total, there are 23 positive deviations, many of which exceed +10, indicating strong growth. Conversely, 27 negative deviations highlight declines in performance, with extreme values like -30, -27, and -25 reflecting significant challenges. The average deviation leans slightly positive, suggesting an overall improvement trend despite the presence of substantial negative outliers. The data reveals a dynamic performance distribution, with individuals experiencing either notable gains or losses, indicating diverse outcomes across the group.

Range of Normal and Abnormal Deviation from Graph

Normal Range:

- Observing the graph, the deviations mostly fluctuate around the **0-line**, with some peaks and dips.
- A reasonable **normal range** would be **between -10 and +10**, as most values appear within this interval.

Abnormal Range:

- **Significant deviations** beyond this normal range can be classified as abnormal.
- Values **greater than +10** or **less than -10** can be considered **abnormal**.

- The extreme peaks around +20 to +30 and -20 to -30 indicate **high deviation**, suggesting notable variations.

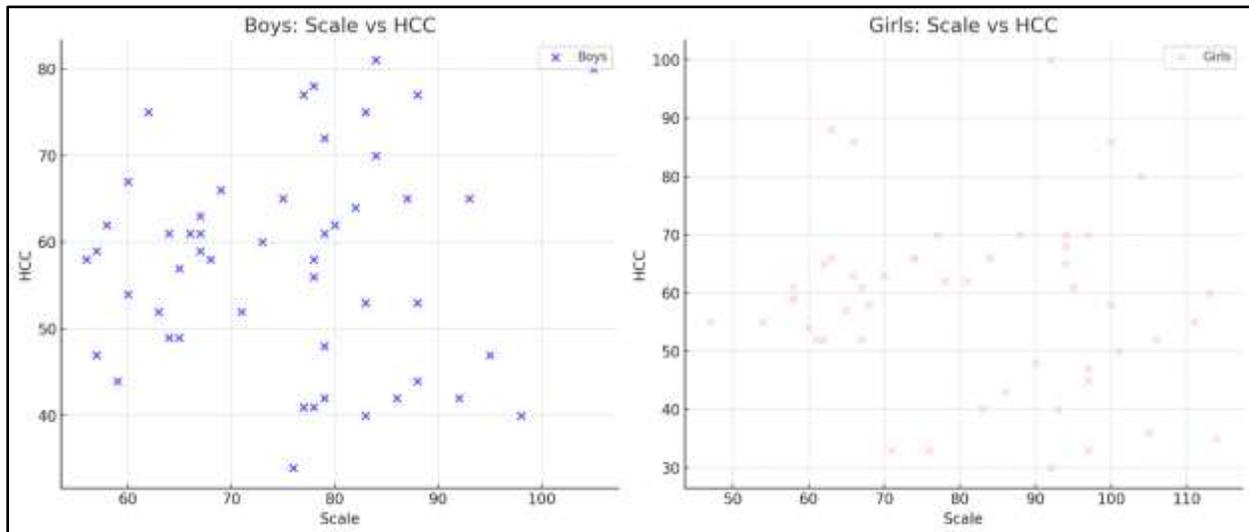


Fig – 5 shown that Boys and Girls Comparison of Scale VS HCC

Boys:

- **SCALE:** Mean = 75.4, Std. Dev = 11.85, Min = 56, Max = 105
- **HCC:** Mean = 57.74, Std. Dev = 12.03, Min = 34, Max = 81

Girls:

- **SCALE:** Mean = 81.46, Std. Dev = 17.76, Min = 47, Max = 114
- **HCC:** Mean = 58.12, Std. Dev = 15.02, Min = 30, Max = 100

Observations:

1. Girls have a higher average score in both SCALE and HCC compared to boys.
2. Variability (standard deviation) is also higher among girls for both SCALE and HCC.
3. The maximum HCC score (100) is observed in the girls' data.

Visualization:

1. The scatterplots highlight the relationship between SCALE and HCC for boys and girls.
2. Boys' scores are more clustered, while girls' scores show greater spread, particularly in SCALE.

The data and calculate the correlation coefficient (r) between SCALE and HCC for both boys and girls.

The correlation coefficients (r) between SCALE and HCC are:

- **Boys:** $r = 0.0315$ (very weak positive correlation)
- **Girls:** $r = -0.1252$ (weak negative correlation)

This indicates that for boys, there is almost no relationship between SCALE and HCC, while for girls, a weak inverse relationship exists.

Frequency Table

Boys:

HCC Range	Frequency (Boys)
40-50	10
51-60	10
61-70	14
71-80	7
81-90	8
91-100	1

Girls:

HCC Range	Frequency (Girls)
40-50	6
51-60	16
61-70	14
71-80	5
81-90	6
91-100	3

Observed Frequencies (OOO)

From the frequency table:

HCC Range	Boys (O)	Girls (O)	Total (O)
40-50	10	6	16
51-60	10	16	26
61-70	14	14	28
71-80	7	5	12
81-90	8	6	14
91-100	1	3	4
Total	50	50	100

Expected Frequencies (EEE)

The expected frequency for each cell is computed as:

$$E = \frac{(\text{Row Total} \times \text{Column Total})}{\text{Grand Total}}$$

Calculate E for each cell.

Example for "40-50 (Boys)":

$$E = \frac{(16 \times 50)}{100} = 8$$

Example for "40-50 (Girls)":

$$E = \frac{(16 \times 50)}{100} = 8$$

HCC Range	Boys (EEE)	Girls (EEE)
40-50	8	8
51-60	13	13
61-70	14	14
71-80	6	6
81-90	7	7
91-100	2	2

Chi-Square Formula

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

We calculate this for each cell:

For "40-50 (Boys)":

$$\frac{(O - E)^2}{E} = \frac{(10 - 8)^2}{8} = \frac{4}{8} = 0.5$$

For "40-50 (Girls)":

$$\frac{(O - E)^2}{E} = \frac{(6 - 8)^2}{8} = \frac{4}{8} = 0.5$$

Perform the same calculation for all cells.

Chi-Square Calculations

HCC Range	Boys (O,E)	(O,E)	(O-E) ² /E Boys	(O-E) ² /E Girls
40-50	10,8	6,8	0.5	0.5
51-60	10,13	16,13	0.692	0.692
61-70	14,14	14,14	0	0
71-80	7,6	5,6	0.167	0.167
81-90	8,7	6,7	0.143	0.143
91-100	1,2	3,2	0.5	0.5

Total Chi-Square Value

χ^2 = Sum of all contributions

$$\chi^2 = 0.5 + 0.5 + 0.692 + 0.692 + 0 + 0 + 0.167 + 0.167 + 0.143 + 0.143 + 0.5 + 0.5$$

$$\chi^2 = 3.004$$

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Degrees of Freedom

Degrees of Freedom (df) = (Number of Rows-1) × (Number of Columns-1)

$$df = (6-1) \times (2-1) = 5$$

Critical Value

Using a significance level of 0.05 and df=5, the critical Chi-square value from the Chi-square table is:

$$\chi^2_{\text{critical}} = 11.07$$

Conclusion

- Computed $\chi^2=3.004$
- Critical $\chi^2=11.07$

Since $3.004 < 11.07$

$3.004 < 11.07$

we **fail to reject the null hypothesis**. There is **no significant difference** in the distribution of HCC values between boys and girls.

6. Conclusion

The electronic concentration counter provides an innovative and affordable solution for assessing Anxiety Level. By utilizing W78E052DDG microcontrollers, the system ensures accurate, objective measurements suitable for various applications. Future work will focus on enhancing the device's robustness and integrating additional features, such as wireless data transmission and advanced analytics. Prototype testing on a sample of 50 individuals revealed a high correlation between device-generated concentration scores and psychologists' subjective assessments, confirming the device's reliability. Boys' deviation data showed a mix of performance improvements and declines, with an average deviation of -1.12, while girls' deviations exhibited a wider range, averaging slightly positive and including significant outliers like +40 and -30. Comparison of SCALE and HCC scores highlighted higher averages and variability among girls, with weak or negligible correlations between SCALE and HCC for both groups. A Chi-square test ($\chi^2 = 3.004$, $df = 5$) indicated no significant difference in HCC distributions between boys and girls, supporting the null hypothesis.

References

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