Nocturnalyze: Real-Time Sleep Disturbance Therapeutic Device

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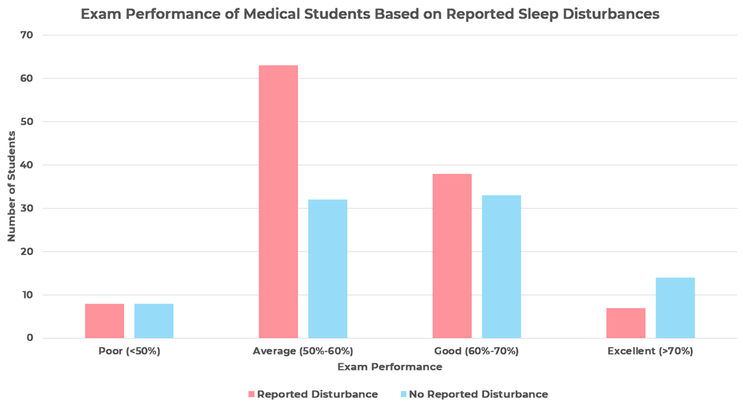
Introduction

PROBLEM

- Sleep disturbances are unmonitored in college students

BACKGROUND

- More than 80% of college students say loss of sleep negatively affects their academic performance
- Light and sound therapy can be used as an intervention



OBJECTIVES

- Create a functioning mattress sensor pad
- Utilize sensor-driven light and sound therapy to automatically trigger when a disturbance is detected

Hypothesis

- A custom mattress sensor pad with an arrangement of force-sensitive resistors alongside sound monitoring will detect sleep disturbances
- Adaptive light/audio therapy will trigger based on detected disturbances and improve sleep quality in college students

Therapy

LIGHT THERAPY

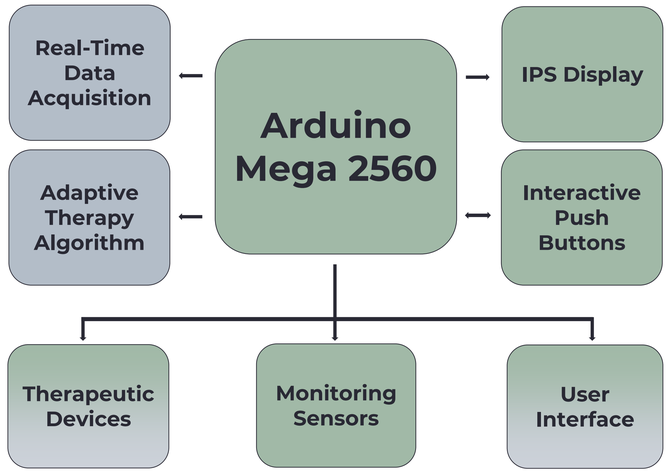
- Activates when the system detects a motion-based disturbance during sleep
- Emits warm yellow light at a wavelength of 590 nm, designed to be non-jarring and calming

PINK NOISE AUDIO THERAPY

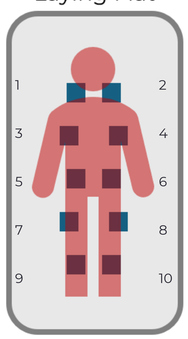
- Engages when a Level 3 disturbance is detected (> 60 dB)
- Generated using RNG to play tones (100 Hz – 8 kHz)
- Helps mask sudden environmental noises and provides a consistent soundscape to soothe the user back to sleep

Methods

- Disturbances monitored by force-sensitive resistor array, microphone, thermistor, and hydrometer
- User data/ambient room data is delivered to the MCU for real-time data processing and recording on an LCD screen
- Therapeutic elements include an LED light bar at yellow light wavelengths and pink noise speaker

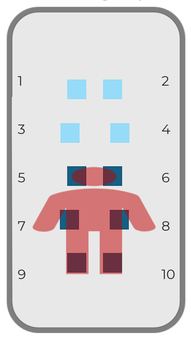


Laying Flat



Sensor #	Sensor Output (lbs)
1	0.2
2	1.0
3	0.2
4	0.2
5	0.1
6	1.1
7	0.5
8	0.7
9	0.4
10	0.8

Sitting Up

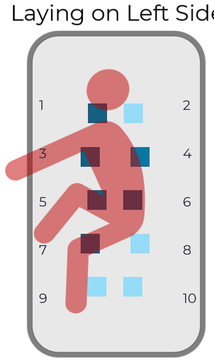


Sensor #	Sensor Output (lbs)
1	0.0
2	0.0
3	0.0
4	0.0
5	3.1
6	2.4
7	0.0
8	0.4
9	0.3
10	0.6

= Little to No Sensor Activity

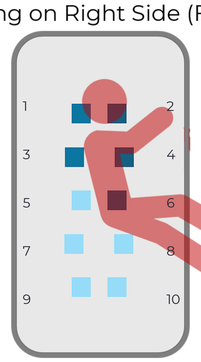
= Significant Sensor Activity

Laying on Left Side



Sensor #	Sensor Output (lbs)
1	0.1
2	0.0
3	1.7
4	0.5
5	1.9
6	1.7
7	0.4
8	0.1
9	0.7
10	0.1

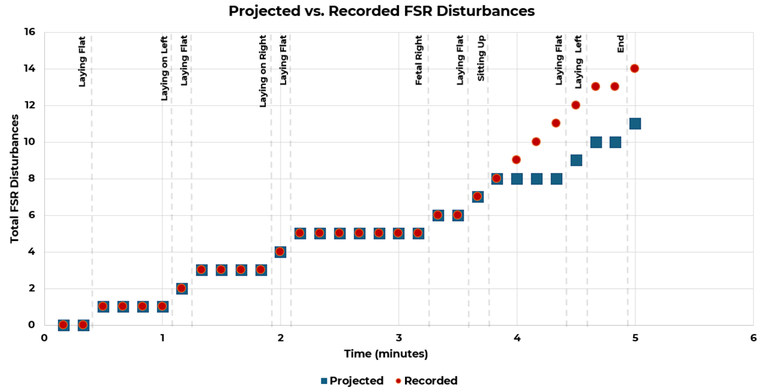
Laying on Right Side (Fetal)

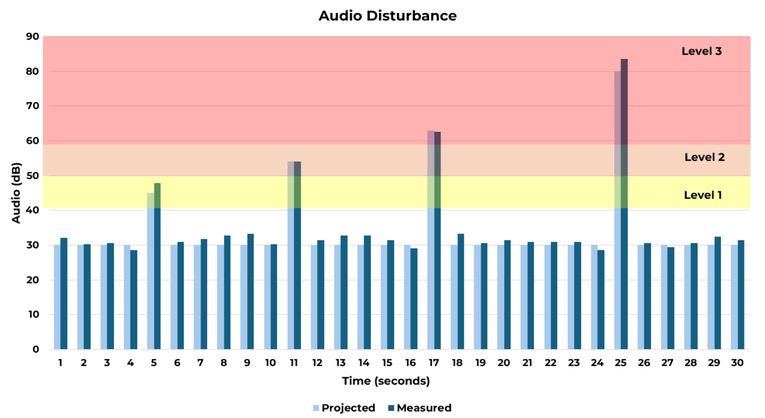


Sensor #	Sensor Output (lbs)
1	0.3
2	2.1
3	0.0
4	0.1
5	2.0
6	1.1
7	0.1
8	0.0
9	0.2
10	0.1

Results

- System detects sleep disturbances with real-time monitoring and displays live data on the LCD screen
- Therapies trigger when a motion or audio disturbance is detected - light therapy and pink noise, respectively





Conclusion

- Nocturnalyze detects simulated disturbances, such as audio and motion induced, with the addition of applied therapies triggered upon disturbance detection
- Novelty in combining the monitoring sensors and the therapeutic elements of the system

Future Work

- Perform trials on college students
- Therapy adjusts based on user response
- Design and fabricate for pre-commercial production
- Design and implement an app to record data