Project Title

(Try to choose a catchy title. Max 20 words).

Rise 'n Riddle: Puzzle Your Morning

Student/Team Information

Team Name if any: **Team # on Canvas you have self-signed-up for:**	***Lonely Riddler***
Team member 1 (Team Lead) (Lastname, Firstname; SDSU email; picture):	*Pielmaier, Julian –* *jpielmaier9966@sdsu.edu* 

Updated Project Approach (10 points)

(Describe how do you plan to articulate and design a solution, architecture you are finally using and communication protocol (Wi-Fi, BLE, ...). Include all project milestones as well. Max 300 words).

The final design is based on the TTGO board serving as the central hub for real-time interactions and sensor data management. Hardware integration has been completed by connecting a 4 LED line for the interactive puzzle display, paired with a set of 4 buttons positioned beneath to capture user input, along with an integrated buzzer for alert notifications. A temperature and humidity sensor is also incorporated to continuously monitor local environmental conditions.

The core software includes essential functionalities. Alarm scheduling is implemented to trigger the interactive challenge at preset times. Upon activation, a random puzzle pattern is generated across the 4 LED line, requiring the user to replicate the displayed pattern using the corresponding buttons. This approach effectively stimulates immediate cognitive engagement upon waking.

Wi-Fi serves as the primary communication protocol, enabling the transmission of environmental sensor data to a remote cloud service hosted on Amazon EC2. Although the temperature and humidity data is successfully transmitted over the network, permanent cloud storage is reserved for a later development phase, allowing for future enhancements in remote logging and performance monitoring.

Key project milestones achieved include:

- **Hardware Integration:** Completion of component assembly and connections, including the 4 LED line, 4-button set, buzzer, and sensor.
- **Core Software Development:** Implementation of alarm scheduling, random puzzle pattern generation, and integration of user input through the buttons.
- **Sensor and Wi-Fi Integration:** Successful retrieval and transmission of sensor data via Wi-Fi, establishing a foundation for future remote logging and configuration enhancements.

Updated Hardware Components (5 pts)

(The final list and quantity of the required components for the project)

Component/part	Quantity
Breadboard	1
LILYGO-TTGO	1
Humidity and Temperature Sensor	1
USB Type-C Cable	1
Buzzer	1
Button	4
LED	4
Resistor	8

Jumper Wires	20

Project Tasks completed so far (15 pts)

(Describe the main tasks that have been assigned and already completed. Max 250 words).

Task Completed	**Team Member**
Progress has been made in developing the interactive alarm system. First, the hardware integration task has been successfully completed. The TTGO board, a 4 LED line for displaying the puzzle, a matching set of 4 buttons for user interaction, an integrated buzzer for notifications, and a temperature/humidity sensor have all been properly assembled and interconnected. Each component has undergone initial functionality testing to ensure seamless integration. On the software side, core functionalities have been implemented. An alarm scheduling module has been developed that triggers the alarm at preset times, launching the interactive challenge reliably. A random puzzle pattern generation algorithm is fully operational, displaying varied patterns on the LED line that must be replicated via the button set. Additionally, sensor integration and wireless communication have been addressed. The temperature and humidity sensor now consistently reads environmental data, which is transmitted via Wi-Fi to an Amazon EC2 instance. Although data storage on the cloud has not been permanently set up, successful transmission establishes the groundwork for future remote logging enhancements	Julian

Challenges/roadblocks (10 pts)

(Describe the challenges that you have faced or are facing so far and how you plan to solve them. Max 300 words).

One significant hardware constraint was the limited number of available GPIO pins on the ESP32, which necessitated using a 4 LED line and 4 buttons instead of the originally planned 3x3 configuration. This restriction required revisiting the design to ensure that the reduced interaction surface still met the project's core objectives.

Another hardware challenge involved connecting all components on a constrained breadboard. Limited space and initial unfamiliarity with optimal wiring techniques led to several trials and adjustments to achieve stable and reliable connections among the TTGO board, LEDs, buttons, buzzer, and sensor. To resolve these issues, careful planning of the layout and incremental testing were employed, ensuring that each component functioned correctly before integrating them into the complete system.

On the software side, interfacing the random puzzle generation with the new button configuration

raised some integration challenges. Debugging the input response logic to accurately capture and compare user inputs with the generated patterns took additional iterations.

Overall, the approach to overcoming these challenges includes iterative testing, refinement of hardware layout, and software debugging practices. With each identified problem, targeted solutions have been explored to ensure that both hardware and software components perform seamlessly as development progresses.

Tasks pending (10 pts)

(Describe the main tasks that you still need to complete. Max 250 words).

Task Pending	**Team Member**
The project still has several key tasks to complete before the system can be considered fully functional. First, the development of permanent remote logging and configuration features is pending. Although sensor data (temperature and humidity) is successfully transmitted via Wi-Fi to an Amazon EC2 instance, implementing persistent cloud storage and a companion dashboard for long-term trend analysis remains a future objective. Another critical task is to finalize the adaptive difficulty algorithm. This algorithm will adjust the challenge level of the LED puzzle based on metrics such as reaction time and the number of attempts, ensuring that the cognitive challenge remains balanced and engaging as performance data is recorded. Additionally, the sleep rating system, which allows users to rate their sleep quality from 1 to 9, has yet to be integrated. This feature is expected to provide valuable subjective insights into sleep patterns when combined with the objective performance and environmental data. Finally, thorough system-wide testing and calibration are necessary to ensure seamless operation across all components and functionalities. This includes further refining the hardware and software integrations to improve reliability, as well as preparing a final demonstration video that will showcase the system architecture, alarm triggering, puzzle interaction, sleep rating process, and environmental monitoring capabilities.	Julian

Weak points / Future work (15 pts)

(Mention at least two points of your project that have room for improvement. These points can be additions to the existing project setup (components) or improvement of the current implementation. Max 200 words).

One limitation is that the cognitive challenge, currently implemented with a 4 LED line and matching 4-button set, is inherently less demanding than the originally envisioned setup. With fewer elements to remember and reproduce, the puzzle is easier for users. To counteract this, future iterations may incorporate shorter delays between LED blinks or adjust timing constraints to increase the challenge and better stimulate cognitive activation.

Another notable area for improvement is the absence of a dedicated user interface for remote configuration and performance analysis. Although sensor data is currently transmitted via Wi-Fi to an Amazon EC2 instance, there is no companion dashboard or app that allows users to interact with the system. A proper user interface would facilitate adjustments of alarm settings, deliver visual insights into logged metrics like reaction times, and serve as an input method for sleep ratings. Future work could involve developing an intuitive mobile or web application that integrates these features, ultimately making the system more accessible and beneficial for end users.