MINI PROJECT REPORT ON
ALARM FOR SLEEP PREVENTION

GUIDE:

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Abstract:

In our fast-paced contemporary society, the pervasive issue of sleep deprivation demands innovative solutions to safeguard individuals' well-being and performance. This mini-project introduces a groundbreaking system, amalgamating a tilt sensor with an alarm mechanism, aimed at dynamically detecting signs of drowsiness or sleep onset. The conventional reliance on time-based alarms is scrutinized, prompting the exploration of a responsive system capable of adapting to an individual's fluctuating state of alertness.

Motivated by the urgent need to address the far-reaching consequences of sleep deprivation on cognitive function and safety, this project envisions a comprehensive solution. The proposed tilt sensor-based system presents a dynamic and adaptable approach to enhance overall sleep hygiene. With its potential applications spanning security, productivity, and well-being, the project serves as a catalyst for innovation in sleep prevention technology.

As we delve into the project's objectives, methodology, and literature review, a holistic understanding of the multifaceted nature of sleep-related challenges emerges. The abstract sets the stage for a detailed exploration of how the integration of a tilt sensor with an alarm system could revolutionize our approach to mitigating the detrimental effects of sleep deprivation in diverse real-world scenarios.

INTRODUCTION:

In the contemporary landscape characterized by incessant demands and accelerated lifestyles, the pervasive concern of sleep deprivation emerges as a critical challenge affecting health, cognitive function, and societal safety. This mini-project pioneers a transformative solution, introducing an amalgamation of a tilt sensor and an alarm system. This dynamic integration aims to detect signs of drowsiness or sleep onset, surpassing the limitations of conventional time-based alarms and addressing the dynamic nature of individual alertness.

Acknowledging the inadequacies of existing alarm systems that operate on fixed time intervals, the introduction emphasizes the urgency of a responsive system tailored to human variability. The project lays the foundation for exploring innovative sleep prevention technology, emphasizing the need for adaptability and real-time responsiveness to promote healthier sleep habits and mitigate the risks associated with sleep deprivation.

By underscoring the potential applications of the proposed system in diverse sectors, including security, productivity, and overall well-being, the introduction invites readers to delve into the intricacies of the project's objectives, methodology, and literature review. It sets a compelling context for understanding how the integration of a tilt sensor with an alarm system could revolutionize our collective approach to addressing the multifaceted challenges posed by sleep deprivation in our contemporary, high-paced world.

MOTIVATION:

The motivation driving this project is deeply rooted in the imperative to confront and mitigate the far-reaching consequences of sleep deprivation within the contemporary societal fabric. The prevailing alarm systems, predominantly anchored in fixed time intervals, lack the adaptability required to accommodate the dynamic nature of human alertness. The pressing repercussions of compromised cognitive function diminished productivity, and safety hazards propel this project toward the exploration of a novel solution.

The urgency stems from the realization that sleep deprivation is not merely an individual concern but a societal challenge with cascading effects. Motivated by the imperative to improve the quality of life and performance, this project envisions a tilt sensor-based system as a proactive measure to intervene in the onset of sleep or drowsiness. The innovative tilt sensor integration seeks to provide a dynamic, real-time response, thereby challenging the status quo of time-dependent alarm systems.

This motivation serves as the driving force behind the meticulous exploration of a comprehensive sleep prevention system. It underscores the project's commitment to offering a solution that not only addresses individual well-being but also contributes to a broader societal enhancement by mitigating the adverse impacts of sleep deprivation on cognitive abilities, safety, and overall productivity.

OBJECTIVES:

The multifaceted objectives of this project are intricately designed to pave the way for a comprehensive and impactful solution to the prevalent issue of sleep deprivation. Each objective serves as a strategic pillar, collectively aiming to create a system that transcends the limitations of conventional alarms:

1. **Develop a Reliable Tilt Sensor-Based Sleep Detection System:** The foremost objective involves the meticulous design and implementation of a cutting-edge sleep detection system. The emphasis lies in harnessing the capabilities of a tilt sensor to dynamically capture signs of drowsiness or sleep onset, thereby laying the foundation for an innovative preventive mechanism.

2. **Implement an Alarm Mechanism Responsive to Signs of Drowsiness or Sleep:** This objective focuses on translating the input from the tilt sensor into an effective alarm mechanism. The goal is to create a responsive system that triggers timely alarms upon detecting subtle indicators of drowsiness, thereby proactively addressing the onset of sleep and preventing potential hazards.

3. **Create a User-Friendly Interface for System Configuration and Use:** Recognizing the importance of accessibility, the project endeavours to develop an intuitive and user-friendly interface. This objective ensures that users can easily

configure and interact with the system, promoting widespread adoption and usability across diverse settings.

4. **Ensure the System's Efficacy in Real-World Scenarios:** The practical applicability of the proposed system is scrutinized through rigorous testing in real-world scenarios. This objective aims to validate the system's reliability, responsiveness, and effectiveness, ensuring its seamless integration into various environments where sleep prevention is crucial.

5. **Evaluate User Satisfaction and Collect Feedback for Continuous Improvement:** Beyond functionality, user satisfaction becomes a paramount consideration. This objective involves soliciting feedback from users to gauge their experience with the system, enabling iterative improvements and enhancements to cater to evolving needs.

These interconnected objectives collectively form a robust framework, guiding the project toward the development of a dynamic tilt sensor-based sleep prevention system with the potential to redefine approaches to sleep-related challenges in diverse settings.

LITERATURE REVIEW:

The literature review serves as a compass, navigating through the vast landscape of existing research to inform and shape the foundations of this project. The focus centres on the paper titled "Detecting Driver Drowsiness Based on Sensors: A Review," which provides valuable insights into various methodologies for drowsiness detection. The comprehensive review explores three primary categories: vehicle-based, behavioural, and physiological measures. [1]

1. **Vehicle-Based Measures**: The analysis reveals the limitations of vehicle-based measures, such as reliance on external conditions like road and weather, which can compromise reliability. Key parameters, including steering wheel movements and lane position deviation, are highlighted. The critical evaluation emphasizes the need for a more robust and independent approach. [2, 2]

2. **Behavioural Measures**: Behavioural indicators, encompassing observable actions like yawning, eyelid closure, and head movements, emerge as non-intrusive and intuitive measures. However, challenges related to changing lighting conditions are acknowledged, underscoring the importance of a balanced and adaptable solution. [4,5,6]

3. **Physiological Measures**: The review underscores the accuracy of physiological measures, involving internal biological signals such as heart rate, eye movements, and brainwave activity. Despite their precision, the invasive nature of close-contact sensors presents a potential hurdle.[7,8,9,10,11]

The synthesis of these findings culminates in a recommendation for a fusion method, integrating physiological measures with behavioural and vehicle-based measures. This fusion approach is poised to enhance the overall reliability and effectiveness of drowsiness detection systems.

By aligning the literature review with the project's objectives, the groundwork is laid for the integration of a tilt sensor as a behavioural measure. This fusion not only draws from existing research but also propels the project into uncharted territory, offering a promising avenue for developing a responsive and comprehensive sleep prevention system.

METHODOLOGY:

The methodology of this project is a carefully orchestrated plan, informed by the insights gleaned from the literature review, aimed at transforming the conceptualization of a tilt sensor-based sleep prevention system into a tangible and functional reality.

1. **Behavioural Measure Integration Using a Tilt Sensor:** Building upon the literature review's emphasis on behavioural measures, the project adopts a tilt sensor as a pivotal component. The AT407 basic tilt sensor is strategically employed to detect subtle head movements or nodding, acting as an intuitive behavioural measure indicative of drowsiness.

2. **Circuit Design and Component Integration:** The hardware implementation involves the synergy of various electronic components, including capacitors, rectifier diodes, resistors, a 555 Timer, and a relay. This amalgamation is orchestrated to create a seamless circuit capable of interpreting the signals from the tilt sensor and activating the alarm mechanism promptly.

3. **Simulation in Flux.ai and Tinkercad:** The design process kicks off with the creation of a comprehensive circuit using Flux.ai, offering a virtual platform for meticulous planning and simulation. Tinkercad serves as the canvas for hardware implementation, allowing for real-time testing and refinement before venturing into physical prototyping.

4. **Buzzer and Power Supply Configuration:** The project strategically opts for a buzzer with an 85 dB output, ensuring a robust auditory alert upon tilt sensor activation. A simple 9V battery serves as the power supply, which is regulated to 5V using LM7805 providing the necessary energy for sustained and reliable operation.

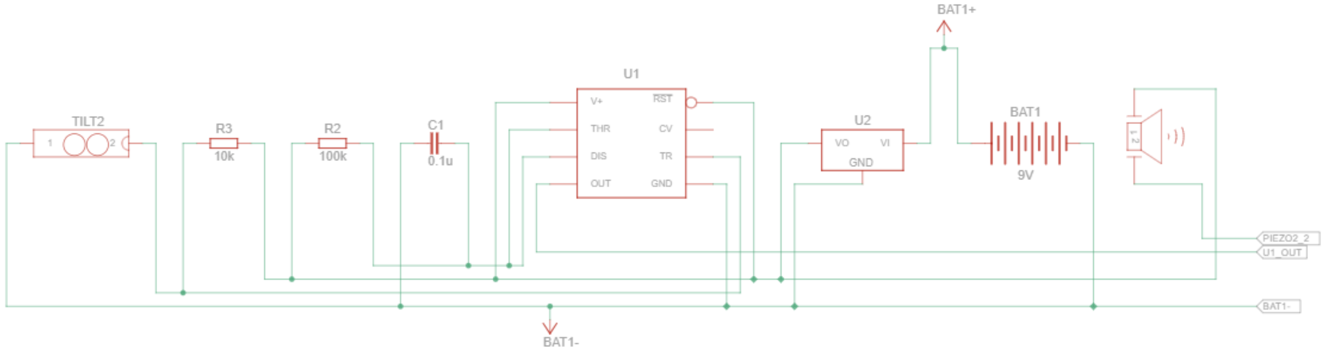
5. **Real-World Testing and Calibration:** Following successful simulations, the hardware implementation undergoes rigorous real-world testing. Calibration is a crucial phase, fine-tuning the system's responsiveness to ensure accurate detection of drowsiness indicators. Test subjects are enlisted to validate the system's efficacy and reliability in diverse scenarios.

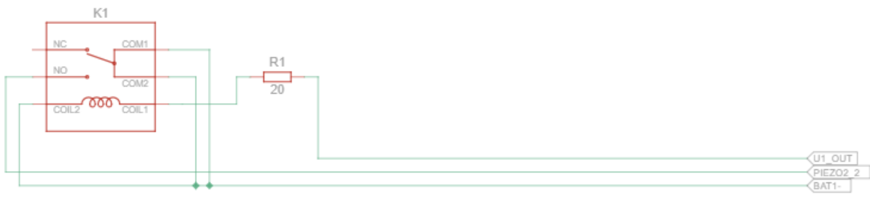
The methodology not only underscores the technical intricacies of circuit design and integration but also emphasizes the importance of real-world applicability and user experience. By navigating through each phase with precision, the project aims to materialize an innovative sleep prevention system that seamlessly blends behavioural measures with electronic components for a responsive and effective solution.

WORK DONE:

Week 1-2	WEEK 3-7	WEEK 8-9
SEPTEMBER	OCTOBER	NOVEMBER
Research and select appropriate components for the system	Designing the circuit and Implementing the idea with hardware components	Completing the project and preparing final evaluation presentation

1. The above figure gives a brief idea about the progress made for the mini-project.
2. The timeline was strictly adhered to, and the final evaluation report was made accordingly.
3. The final circuit design was done on Tinkercad.
4. Tinkercad had a variety of inbuilt features that helped us throughout the project.
5. The knowledge of the 555 timer, integrated as a monostable multivibrator, was used in the making of the circuit.
6. The knowledge of LM7805, used as a voltage regulator was also used.
7. Further research was done to figure out the workings of the SPD relay, this further increased our knowledge about the topic.
8. The final circuit was simulated in Tinkercad along with a tilt response being generated in real-time.
9. The deep analysis of the working of the circuit is given below:





The tilt sensor, AT407 acts as a trigger for the 555 timer IC.

Figures 1 and 2 depict the circuit diagram and internal block diagram, while Figure 3 illustrates the waveforms generated. The monostable multivibrator, operating in "one-shot" pulse generator mode, has a single stable state. Upon the application of a negative trigger pulse to the trigger comparator (Figures 2 and 3), the flip-flop is initially in the RESET state, allowing the discharge transistor to saturate. Simultaneously, the connected capacitor (C) discharges completely, resulting in a low (0) output at pin 3.

As the trigger voltage falls below 1/3 VCC, the comparator 2 output goes high, setting the flip-flop. This action turns off the discharge transistor, initiating the exponential charging of capacitor C. The rising voltage across the capacitor, representing the threshold voltage at pin 6, is compared with a reference voltage of 2/3 VCC by comparator 1. The output at pin 3 stays high until the capacitor voltage reaches 2/3 VCC (Figures 2 and 3).

Upon surpassing this threshold, the output of comparator 1 goes high, resetting the flip-flop. Consequently, the output at pin 3 returns to low (logic 0), indicating the restoration of the stable state. As the output turns low, the discharge transistor saturates again, completing the cycle by fully discharging the capacitor. This dynamic sequence of events characterizes the operation of the monostable multivibrator.

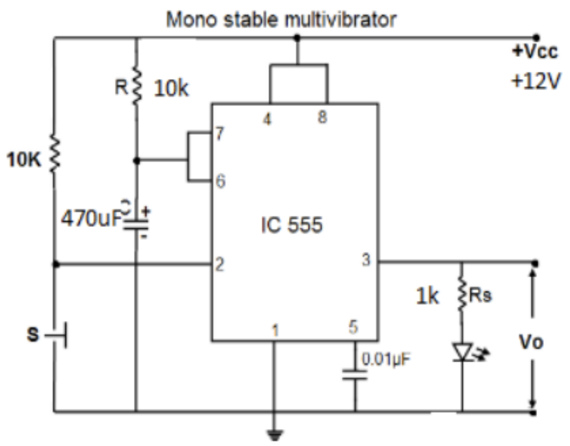


Figure1: Monostable Multivibrator

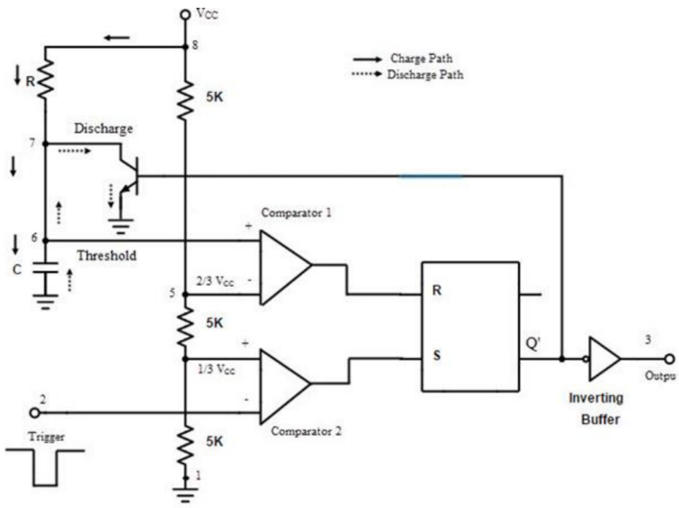


Figure 2: Monostable Multivibrator along with Internal Block Diagram

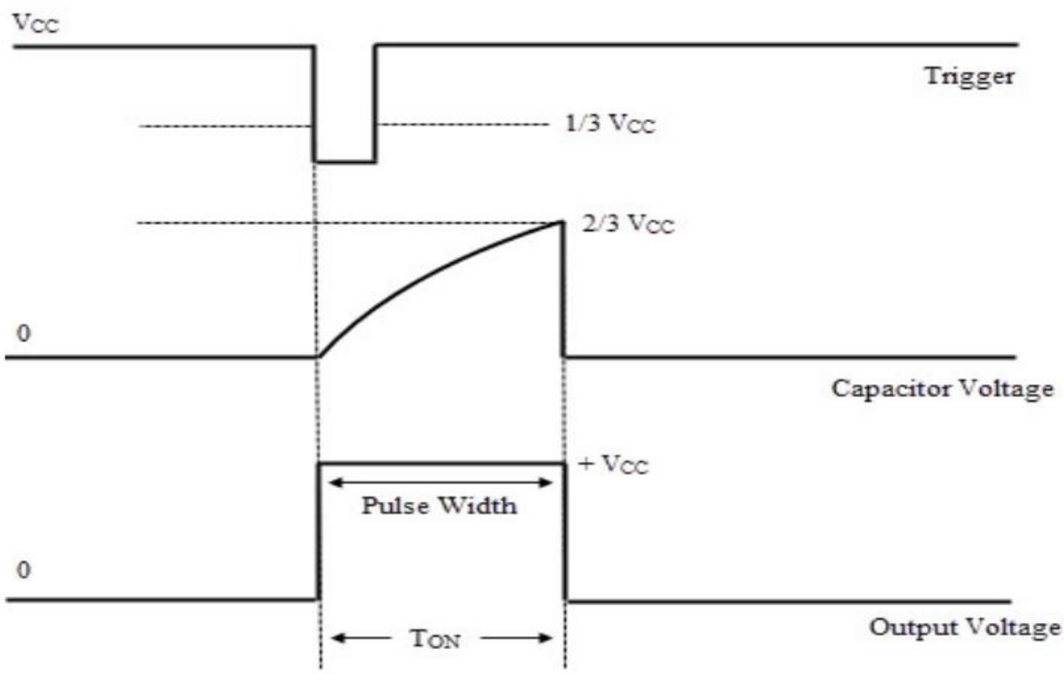
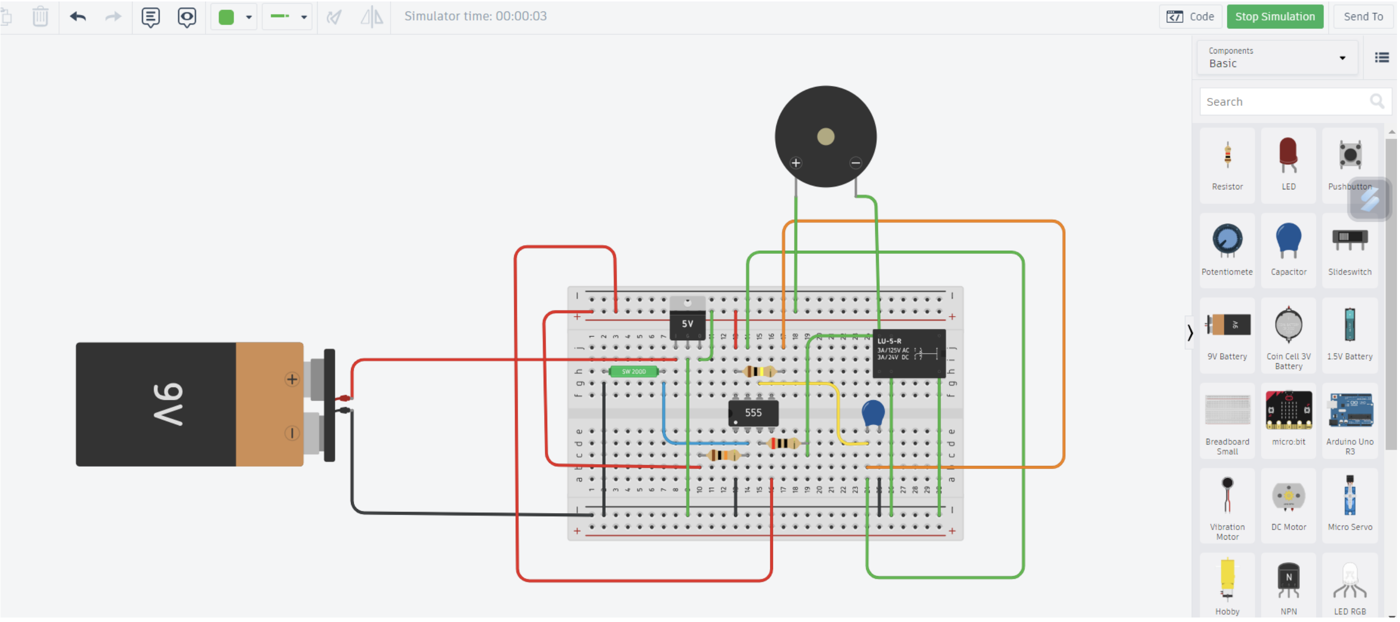


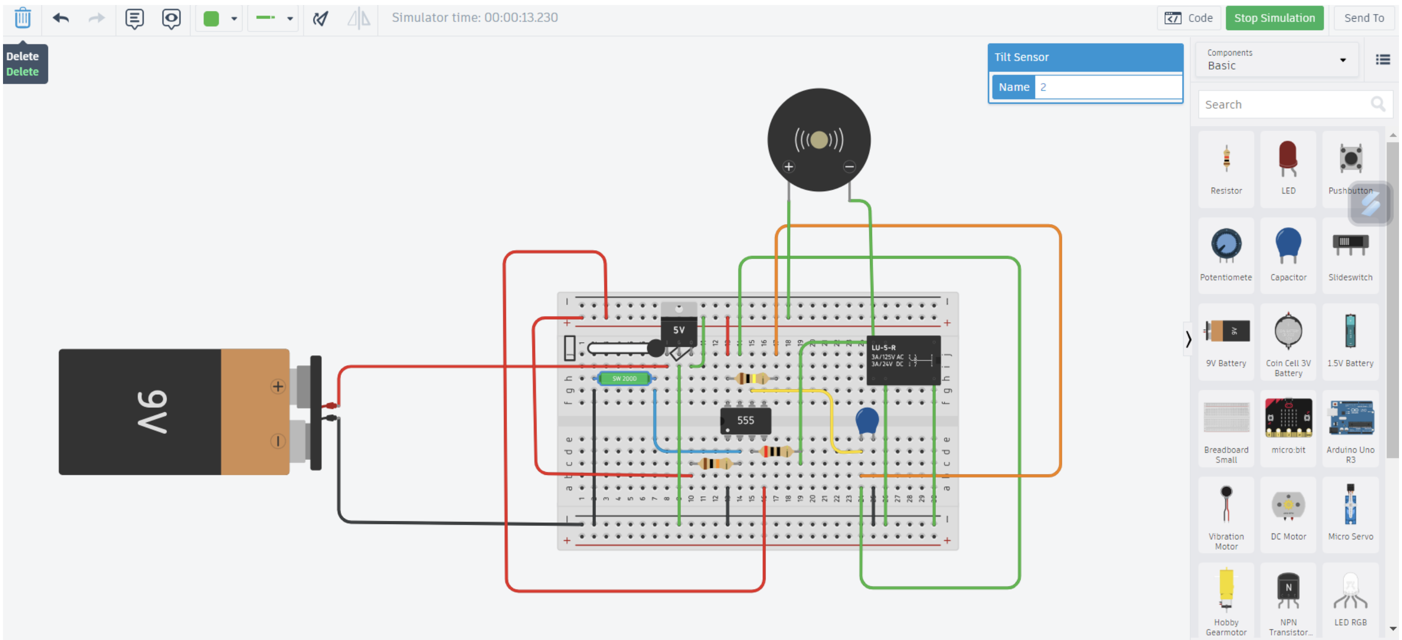
Figure 3: Waveforms Generated with Monostable Multivibrator

RESULTS:

- The final circuit simulation provided us with various insights into the workings of the alarm and the problems that would arise in physical implementation.
- The simulated circuit is provided below:

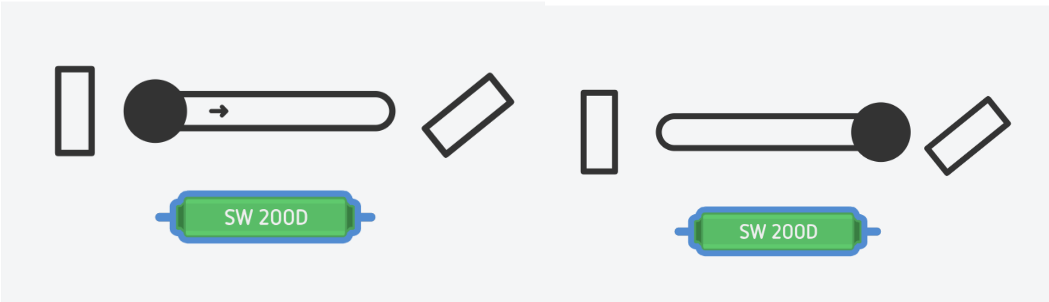


When the tilt sensor does not give any output

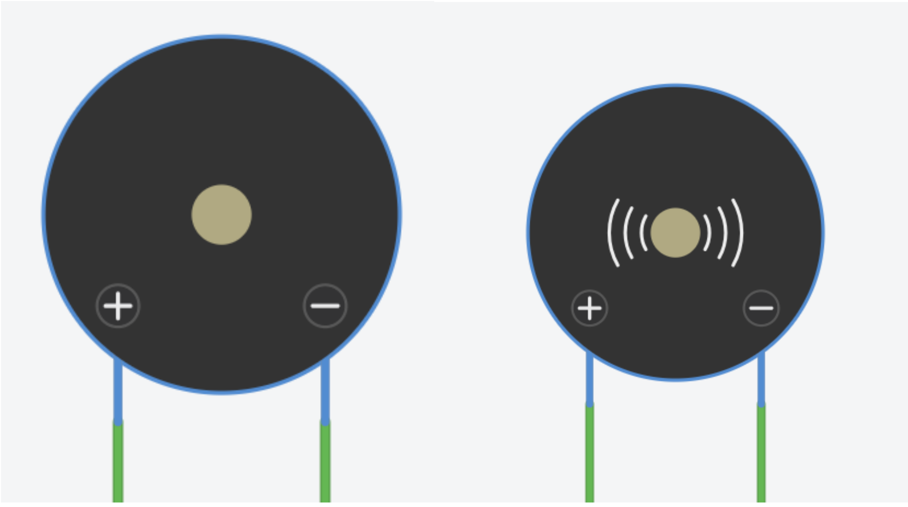


When there is a tilt observed

- The observation of the tilt was done through the inbuilt real-time response in Tinkercad. Like:



No tilt Substantial tilt



Buzzer off Buzzer on

- Audio readings were also done during the observations.
- The final results we arrived at were:
    1. The circuit showed a response for the input of the tilt sensor.
    2. The LM7805 was a cheap and reliable voltage regulator that performed its task.
    3. The buzzer used in the circuit, did not have an 85 dB output but it showed a precise response for a tilt observed.
    4. The response happens after a delay before and after the tilt.
    5. After the tilt sensor goes back to its initial position the buzzer turns off after a bit of delay.

DISCUSSION:

The progress of the mini-project, detailed in the above figure, reflects a methodical and well-executed approach. The adherence to the timeline and the utilization of Tinkercad for the final circuit design stand out as key strengths. The integrated features of Tinkercad proved instrumental throughout the project, facilitating a seamless simulation of the circuit.

The incorporation of the 555 timer as a monostable multivibrator and the LM7805 as a voltage regulator showcases a deep understanding of essential components. Furthermore, additional research into the SPD relay enhanced the team's knowledge base, contributing to a comprehensive grasp of the project's intricacies.

The simulated circuit, with real-time tilt response, offered valuable insights into the alarm's functionality and potential challenges in physical implementation. The provided observations and simulated results depict a clear correlation between tilt sensor input and alarm response. The inclusion of audio readings during observations adds a qualitative dimension to the evaluation.

The identified results underscore the success of the project:

1. The circuit responsively reacts to the tilt sensor input.
2. The LM7805 serves as a cost-effective and reliable voltage regulator.
3. Despite the buzzer not achieving an 85 dB output, it exhibits precise responsiveness to observed tilts.
4. Delays before and after the tilt, along with the cessation of the buzzer after the sensor returns to its initial position, contribute to the system's effectiveness.

In summary, the mini-project demonstrates a holistic understanding of circuit design, sensor integration, and simulation. The results and discussions provide a comprehensive evaluation, affirming the project's success in achieving its objectives and validating the proposed solution's functionality.

CONCLUSION:

By seamlessly integrating a tilt sensor with an alarm system, our innovative solution addresses the critical gap left by conventional time-based alarms. The LM7805 regulates the 9V DC input to 5V output. The buzzer operates at a current rating of 8.33 mA and a voltage rating of 4.94V at max. The capacitor of 0.7 µF operates at a voltage rating of 3.32V and 27.6µA at max. The max output voltage for the 555 timer is 4.53V. The SPD relay operates at a max voltage rating of 3.9V and a max current rating of 31.2 mA.

FUTURE WORK:

In the future, we envision enhancing this system by incorporating Bluetooth for remote detection, using software interface for monitoring, machine learning algorithms to better detect subtle signs of drowsiness and personalizing alarm settings for individual users. Additionally, we aim to explore opportunities for integrating this technology into various domains, such as automotive safety systems, workplace safety, and healthcare applications. By addressing the problem of sleep deprivation with this innovative approach, we hope to contribute to improved safety, productivity, and overall well-being for individuals in our modern, sleep-deprived society, thereby enhancing public safety and making this world a better place.

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