

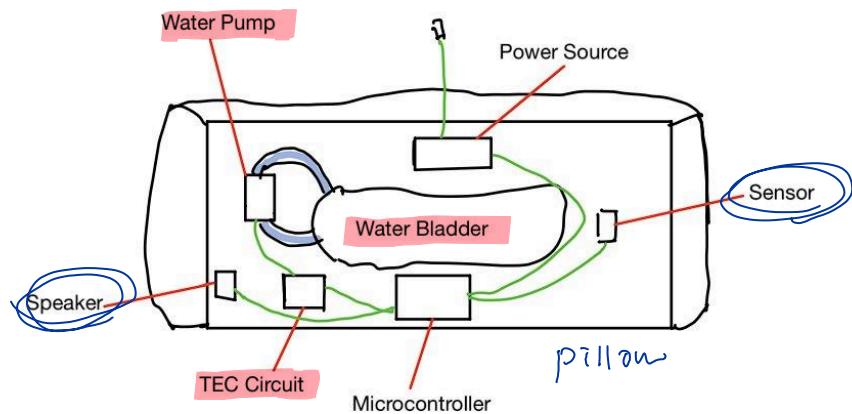
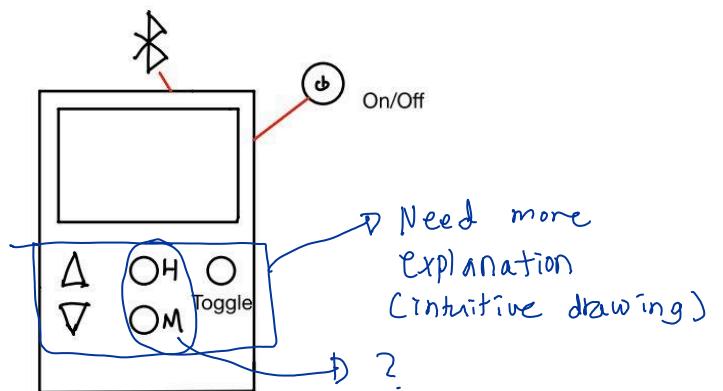
Smart Pillow

- Team 26 -

(Richard Von Tersch, Noah Morken, Jiawei Li,
Ruihang Ni)

Design Document - Rev. 1

bluetooth controller ?.



Product Sketch

TA : Soomin Moon

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Revision Log

Date	Revision	Changes

Table 0.1: Revision Log

Glossary

TEC: Thermo-electric cooler (uses peltier effect)

PID: Proportional–integral–derivative

1 Introduction

1.1 Executive Description

Our product is a smart pillow that has two parts, the pillow itself and a bluetooth controller. The pillow is able to cool and heat itself to users' desired temperature set by the controller, it will also be able to wake the user up by an alarm system, and the user can use the snooze function if the user wants to have a bit more sleep. The pillow will have a water bladder and a water pump to circulate water inside the pillow, and we will be using a TEC circuit to cool and heat the water inside the water bladder.

1.2 User Story

Denice is an average college student in ECE, plagued by a poor night's sleep and tragically afflicted by a 7:30 am lecture. She can't sleep at night in the summer as her pillow becomes rank with heat, and she struggles to rest at first in the winter with the rigid cold pillow. Additionally, in her cramped dorm, Denice has two roommates, two roommates who -unlike Denice- need not be awake at 7:30 and would much prefer not to be. Denice's alarm rouses them from their slumber, and as such she earns their early morning ire. To solve the issues of her struggles with sleep and roommates disdain in one fell swoop, Denice wanted to develop a pillow: a pillow that will cool her when she's hot, warm her when she's cold, and wake her silently when others around her are asleep.

- { temp. Control
alarm System

Needs a little more explanation about the bluetooth sensor in general & the pillow's sensor & speaker in the sketch, maybe include power source.

2 Design Requirements

2.1 Requirements

1. Comfortable → pillow ?
2. Safe (heat resistant)
3. Desired temperature is controllable → explain in terms of the control buttons .
4. Quiet → alarm or the temp control part in the pillow ?.
5. Durable → explain in detail .
6. Alarm is loud enough to wake up user → explain how the speaker technically works in order to wake up user .
7. Alarm is not so loud as to wake up nearby people ✓ Good .
8. Compact (portable) → pillow or the bluetooth controller ?.
9. Affordable
10. Must live long enough to last a whole night → explain in terms of the connected power source in the sketch .

2.2 Factors influencing requirements

1. Public Health, Safety and Welfare
 - a) If the pillow is not adequately heat resistant then it could be a fire hazard to both the user and the building.
 - b) If the pillow is too loud it will disrupt the user's sleep, not only defeating the purpose of the design but also leading to increased health risks due to inadequate sleep.
↳ Cause hearing or attention problems of the user .
2. Global Factors
 - a) Material availability may vary from different countries and we should attempt to pick something fairly ubiquitous.
3. Cultural Factors
 - a) We will consider the shape of the pillow to meet all people with different cultural habits. Like a square pillow in Europe and rectangle pillow in America.
 - b) The softness of material will be considered to meet all people's needs, like using the

combination of cotton and fiber. ✓ Good

4. Social Factors

- a) Roommates won't like you if your alarm wakes them up ✓

5. Environmental Factors

- a) Test that the cooling functionality is effective in different environmental conditions ✓ Good .
- b) Test the volume of the alarm to optimize its capacity to wake up only the user ✓ Should be mentioned in the requirements .

6. Economic Factors

- a) Alarm functionality must not cost significant upcharge; user would simply prefer just the cooling otherwise ✓ very good .
- b) Pillow must be reasonably cheap ✓

3 System Overview

3.1 System Block Diagram

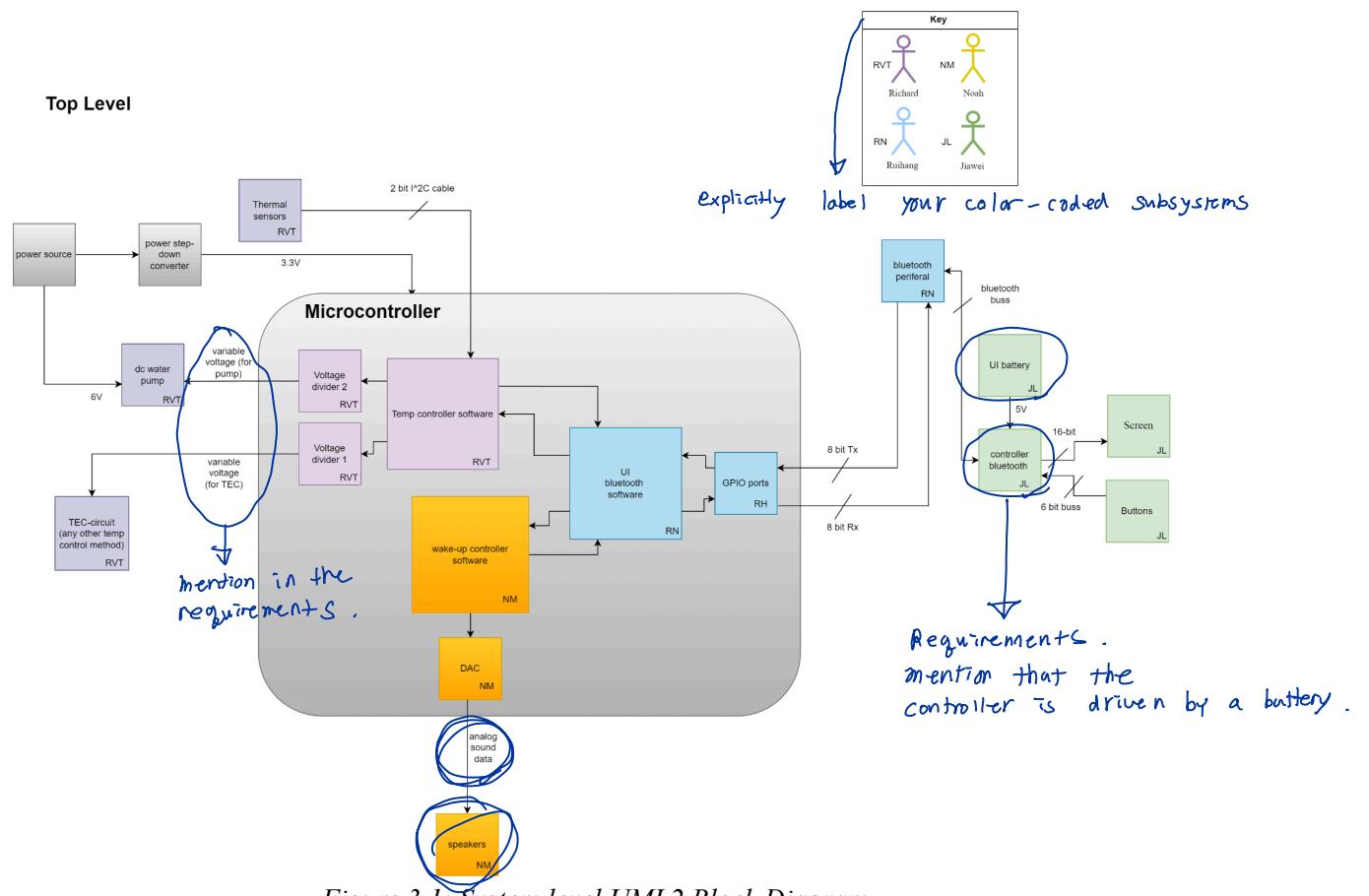


Figure 3.1: System level UML2 Block Diagram

3.2 System Activity Diagram

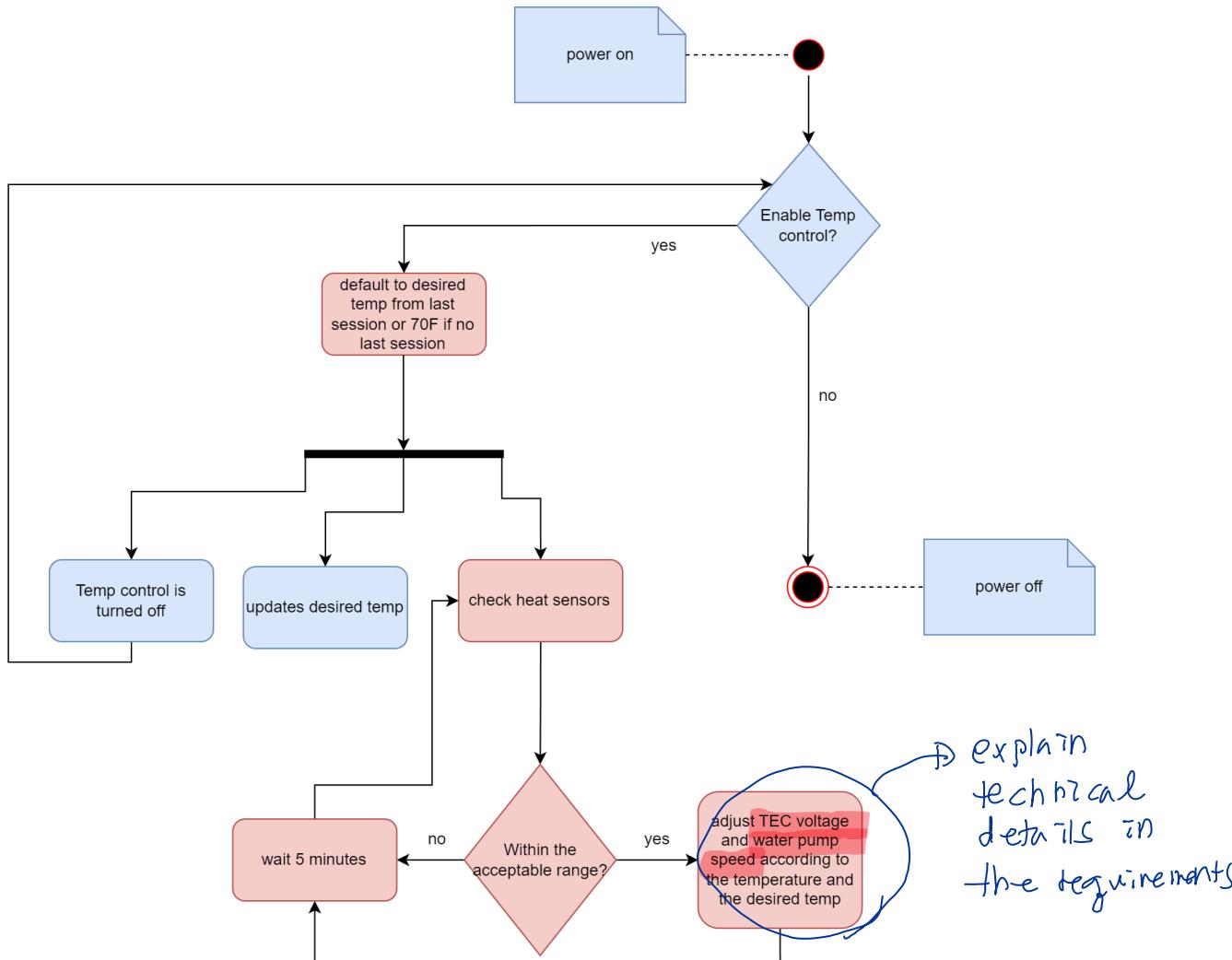


Figure 3.2: Thermal System Activity Diagram

Good
clear.

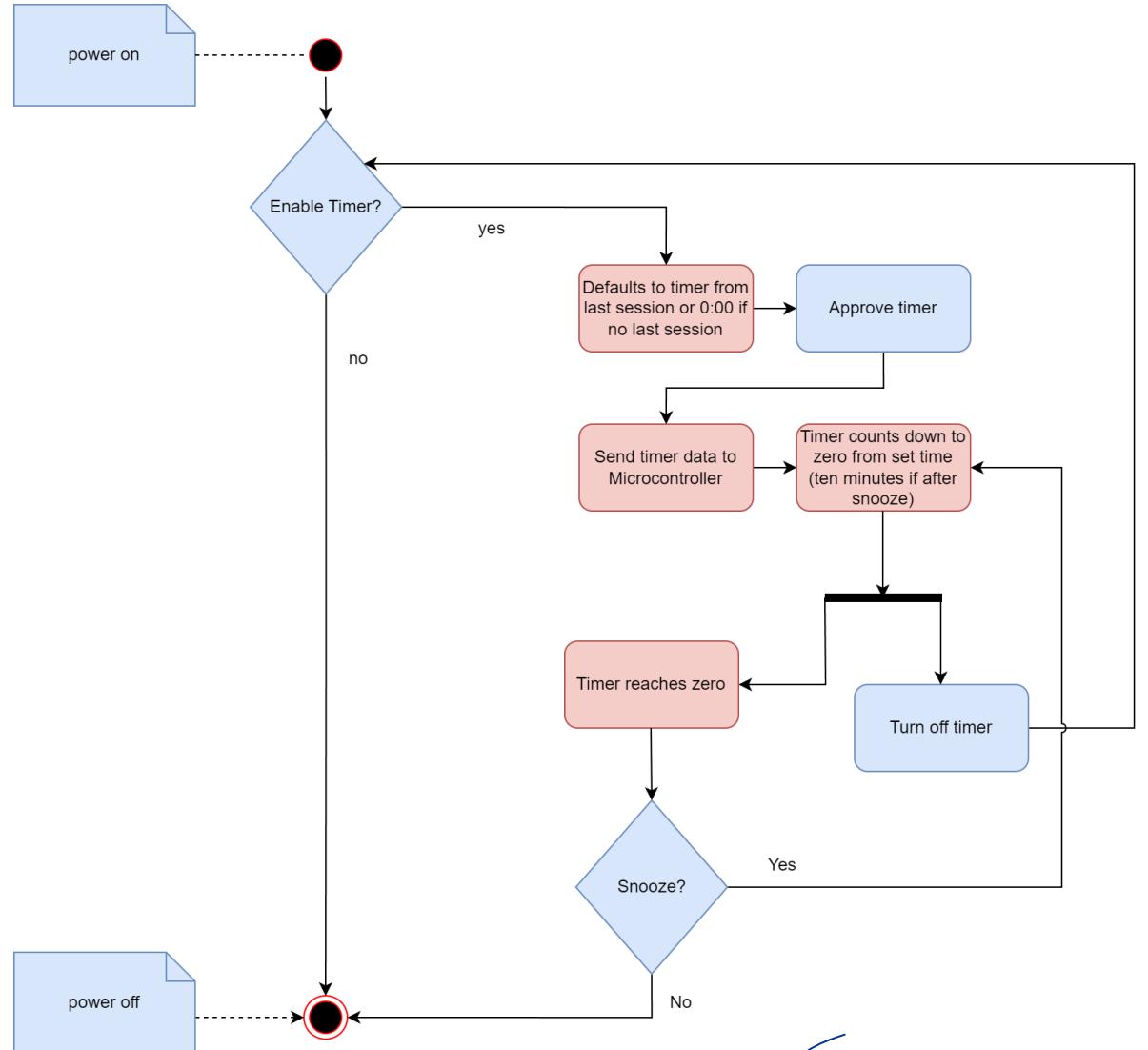


Figure 3.3: *Audio System Activity Diagram*

✓ Good .
clear .

4 Team Structure



Richard VonTersch

Major : Computer Engineering

Contact : rvonters@purdue.edu

Skills : System verilog, Python, C, and Matlab

Previous Projects : Basic udp software defined network, 2-core cpu for MIPS based instruction set, rudimentary convolution based voice changer

My name is Richard VonTersch, I am currently a senior in computer engineering at Purdue University, with a specialization in computer system and a minor in philosophy. My role is the **team lead**, and I am in charge of **the temperature regulation sub-system**. I have experience in digital hardware design, multi-threaded software programing, and microprocessor coding.



Noah Morken

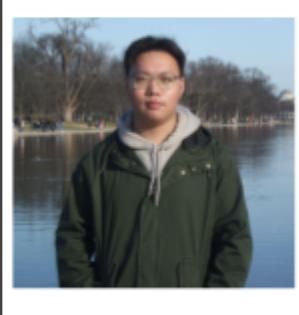
Major : Computer Engineering

Contact : nmorken@purdue.edu

Skills : Verilog, Python, JavaScript

Previous Projects : Audio equalizer, Microprocessor digital circuit, Combinatorial building block digital circuits to complete arithmetic units

I am Noah Morken, a senior at Purdue University with a major in Computer Engineering. My role is the financer, who is tasked with tracking **the budget**, and my main **subsystem is the alarm functionality**. I have experience working with microcontrollers, as well as having done work with producing sound at specific volumes and frequencies. Additionally, I have experience with network security, machine learning, and full-stack website development.



Ruihang Ni

Major : Computer Engineering

Contact : ni102@purdue.edu

Skills : Python, C, Verilog, Database Design,
Microcontroller Programming.

Previous Projects : Enzyme Analysis Algorithm,
Purdue Aerial Robotics Team software team.

My name is Ruihang Ni, I'm a senior in Computer Engineering from Urumqi, Xinjiang, China. My role in our team is communication and I'll be in charge of the UI bluetooth software of our device. I have gained solid experience in microcontroller programming by being a teaching assistance in Microprocessor Systems and Interfacing, besides that, I also have experience in machine learning and data management.



Jiawei Li

Major : Electrical Engineering

Contact : li3697@purdue.edu

Skills : C, Python, Hardware, Battery, GUI

Previous Projects : Hardware team member in
NASA Lunabotics, Metalization with Si wafer
research on Birck Nanotechnology Center

My name is Jiawei Li and I was born in Urumqi, China. I'm currently a senior student in Electrical Engineering at Purdue University. My future career is focused on Electrical motors, Power systems, and Supercharging. My role in this team is facilitator and I will be designing the UI interface and assembling the hardware of the pillow. In addition, I could also help other teammates on software programming.

Bibliography