A product development of smart LED lamp based on BLE (Bluetooth Low Energy)

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1. Introduction

1.1. Description:
We want to design and develop a smart bedside LED lamp with an application, which could turn to different degree of luminance through smart phones. And it can wake you up in the morning at the time you set in the APP. In addition, you can set different modes in the APP to control the lamp. For example, you can set a night mode.

1.2. Background and rationale:
Many friends and I always play smartphones before sleep. The light of smartphones hurts eyes. If a bedside lamp can adjust the lights. Eyes would be relaxed. In addition, plenty of people have a hard time getting up in the morning. If a bedside lamp could automatically turn on and wake people up, it will be amazing. Above all, we want to design and develop a smart bedside lamp to achieve these ideas.

2. Project Details

2.1. Methods:

2.1.1. Knowledge requirement:
Requires programming basics (C, JAVA);
Requires hardware design basics;
Requires BLE permission;

2.1.2. Hardware requirement:
A BLE model, a CC-Debugger,
a LED strip, a step-up power converter,
An Arduino board, a triode

2.1.3. Software requirement:
TI Smart RF Official SDK, IAR.
Android Studio, Arduino IDE

2.2. Use of Standards:

2.2.1. Network Standard:
Bluetooth (BLE).

2.2.2. Software Standard:
JAVA; C.
2.2.3. Open Source Standard:
Windows 7.

2.3. Experiment / Product Results:
We finally design an application based on android to control a light built by LED and BLE. From the app, we sent a command to ask the BLE to send a value ranging from 0 to 255 to the arduino board. The arduino board sends percentage of high voltage of a signal, PWM, to control the triode. The triode performs like a switch and the “on” time is decided by the percentage of high voltage. Then step-up converter gets power from the arduino board to provide the LED strip with power of 12 voltages. Depending on the triode the LED strip get the average voltage to have different lightness.

Our application set a slide bar to control the light’s illumination. We also set two timers. One for sleep function which performs like a count-down and when over, the light will turn off automatically. Another one set a time to make the light on to wake you up at the time point you set.

One difficulty is programming the BLE module since we don’t familiar with the environment and language of embedded system. It costs us quite a long time to complete this section of our project.

3. Cost and Sustainability Analysis

3.1. Economic Impact:
The total economic cost will not higher than 30 dollars, if in mass production, the cost will be reduced. The BLE model will cost about $10, the LED strip will cost $1~$2, and the step up power converter will cost about $5. The most expensive part of our product are some devices which used to help to build this product like CC-Debugger. The advantage of our product compared with other products is the “low-energy” of the Bluetooth part and the power saving feature of LED, so our product will have a good endurance.

3.2. Environmental Impact:
Because the use of BLE and LED, this product will have a good impact for environment.

3.3. Social Impact:
Our product has some positive impact, it could protect teen-agers eyes when they play smart phones at night because of the night mode. Our product adjust to the trend of “low-energy” and “smart home”.

4. Conclusions / Summary
Our project has finally completed, we can use the smart phone to control the lamp on/off, change the luminance by a slider, set a clock to count down to turn off the lamp, set an alarm to automatically turn on the lamp as you want. We have built our circuit and learnt many languages. One meaningful point is that we can study new knowledge like embedded system and android programming. However, we also met difficulty that programming the BLE module since we don’t familiar with the environment and language of embedded system. It costs us quite a long time to complete this section of our project.