A Software Requirements Specification

ON

SMART LED CAMERA

Submitted in Partial Fulfillment for the Award of Degree of Bachelor ofTechnology in Information Technology from Rajasthan Technical University,Kota

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2022-23

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Chapter 1

INTRODUCTION

1.1 Objective

The objective of this project is to create a product that integrates the functionality of a high-quality LED bulb with a discrete, yet powerful, spy camera that can be controlled remotely through a mobile device or computer.

The smart LED bulb with a spy camera will be designed to provide users with a discreet and convenient way to monitor their homes or businesses, without the need for bulky and obvious surveillance equipment. The product will be targeted towards home and business owners who want to monitor their property for security or safety reasons, as well as individuals who are interested in using the spy camera for creative or artistic purposes.

1.2 Project Scope

1. It will be integrated with the LED bulb and will be hidden from view
2. It will be capable of recording video and capturing images in high definition
3. It will be able to transmit data wirelessly to a mobile device or computer

1.3 Technologies and Tools Used

1. Arduino IDE:
    - Arduino IDE is a free and open-source software that is easy to use and has a large community of developers.
    - Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus.
    - It connects to the Arduino hardware to upload programs and communicate with them.

- The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux.
- It supports the programming languages C and C++.
- Easy to Debug

2. ESP32 Cam module

- The ESP32 cam module is a small camera module that is based on the ESP32 microcontroller.
- It includes a high-quality OV2640 camera sensor that is capable of capturing images with a resolution of up to 1600x1200 pixels and video with a resolution of up to 640x480 pixels at 60 frames per second.
- The ESP32 cam module also includes a built-in Wi-Fi module, which allows it to connect to a wireless network and transmit data wirelessly.
- The ESP32 cam module can be programmed using the Arduino IDE, which makes it easy to write and upload code to the module.
- It includes a micro-SD card slot, which allows it to store images and video locally.
- The ESP32 cam module is commonly used for applications such as surveillance cameras, smart home devices, and robotics.

3. LED Bulb

- An LED bulb is a lighting device that utilizes Light Emitting Diodes (LEDs) to produce light.
- LEDs are more energy-efficient than traditional incandescent bulbs and have a longer lifespan.
- LED bulbs can be dimmed using PWM (Pulse Width Modulation) or other techniques, which allows for greater control over the brightness of the light.
- LED bulbs typically have a simple design, consisting of one or more LEDs mounted on a circuit board, with a heat sink to dissipate heat.
- LED bulbs typically use a low voltage DC power supply, which can be provided by batteries or an AC-DC converter.

4. AC to DC converter

- An AC to DC converter is an electrical device that converts Alternating Current (AC) power to Direct Current (DC) power.
- An AC to DC converter is an electrical device that converts Alternating Current (AC) power to Direct Current (DC) power.
- here are two main types of AC to DC converters: linear and switching.
- AC to DC converters are typically rated in terms of their output voltage and current, which determines the amount of power that they can supply.

1.4 Overview

The LED Bulb with ESP32 Cam project involves designing and building a lighting device that incorporates a camera module based on the ESP32 micro-controller. The main goal of this project is to create an LED bulb has the functionality of a spy camera, making it ideal for home security applications.

The LED bulb itself will be designed using common electronic components and will be capable of producing a range of different colors and brightness levels. The ESP32 Cam module will be integrated into the bulb, and will be programmed using the Arduino IDE to allow for remote control and camera functionality.

The project will involve a range of different tasks, including designing the hardware and software components of the LED bulb and ESP32 Cam module, programming the ESP32 to communicate with the camera module, and integrating the components into a working prototype. The project will also involve testing and validation to ensure that the device is safe, reliable, and meets the project requirements.

Overall, the LED Bulb with ESP32 Cam project is an exciting and challenging project that combines hardware design, software development, and electronics engineering skills to create a unique and innovative device with a range of practical applications.

1.5 Product Function

- Remote control: The LED bulb will be controllable remotely, allowing the user to turn it on/off, adjust the brightness, and change the color using a smartphone app.
- Camera functionality: The ESP32 Cam module will be integrated into the LED bulb, allowing it to function as a spy camera. The camera will be accessible through the smartphone app, allowing the user to monitor their home remotely.
- Motion detection: The LED bulb will also be equipped with motion detection sensors, which will trigger the camera to start recording when motion is detected.
- Real-time streaming: The camera will be capable of streaming real-time video to the user's smartphone, allowing them to monitor their home in real-time.
- Data storage: The recorded video footage will be stored on a microSD card inserted in the ESP32 Cam module. The user can access the footage through the smartphone app.
- Power supply: The LED bulb will be powered using a standard AC power supply, which will be converted to DC using an AC to DC converter circuit.

1.6 IoT Basics

The LED Bulb with ESP32 Cam project is an example of an IoT (Internet of Things) project. The following are some of the IoT principles and technologies used in this project:

1. Connectivity: The LED bulb is designed to be connected to the internet using Wi-Fi, allowing it to be controlled remotely via a smartphone app.

2. Embedded systems: The ESP32 microcontroller is a powerful embedded system, providing the computational power and hardware interfaces necessary to control the LED bulb and camera module.

3. Sensors: The LED bulb is equipped with motion detection sensors, allowing it to trigger the camera module when motion is detected.

4. Data storage: The ESP32 Cam module includes a microSD card slot, which allows recorded video footage to be stored for later retrieval and analysis.

5. Cloud computing: The smartphone app used to control the LED bulb and access the camera functionality may rely on cloud computing services to store data and provide real-time communication between the user and the LED bulb.

6. Security: As the device is designed to be used for home security, security measures such as encryption, authentication, and secure data transmission will be implemented to ensure the safety and privacy of the user's data.

1.7 Implementation Constraints

The implementation of the LED Bulb with ESP32 Cam project may face several constraints, including:

1. Power consumption: The LED bulb must be designed to consume low power to ensure it is energy-efficient and to avoid damage to the circuitry. The ESP32 Cam module must also be optimized to consume low power to prevent overheating.

2. Size: The LED bulb must be designed to fit into standard bulb sockets, limiting the size of the device and the components used.

3. Cost: The project must be implemented within a reasonable budget to ensure it is affordable for the end-user.

4. Compatibility: The smartphone app used to control the LED bulb and access the camera functionality must be compatible with a range of devices and operating systems.

5. Reliability: The LED bulb must be designed to operate reliably and with minimal maintenance, ensuring that it functions correctly for an extended period.

1.8 Assumptions and Dependencies

1. Assumptions

    - The Wi-Fi network used to connect the LED bulb to the internet will be stable and have sufficient bandwidth to support the transmission of video data.
    - The user's smartphone will have a compatible operating system and be able to download and install the app used to control the LED bulb and camera module.
    - The user will have basic technical knowledge and be able to set up the LED bulb and camera module without assistance.
    - The ESP32 Cam module will be available and compatible with the LED bulb design.
    - The motion detection sensors will be reliable and able to accurately detect motion.

2. Dependencies:

    - The LED bulb design will depend on the availability of suitable components, such as LED drivers, resistors, and capacitors.
    - The ESP32 Cam module programming will depend on the availability of suitable libraries and APIs for interfacing with the camera module.
    - The camera footage storage and retrieval will depend on the availability of suitable microSD cards and drivers for the ESP32 Cam module.
    - The overall success of the project will depend on the proper integration of all components and proper testing to ensure proper functioning.

Chapter 2

EXTERNAL INTERFACE REQUIREMENTS

2.1 Software Interfaces

The LED Bulb with ESP32 Cam project would have the following external interface requirements:

1. Smartphone app interface: The LED bulb should be controlled using a smartphone app that will be developed for this project. The app should provide the user with the ability to turn the LED bulb on and off, adjust the brightness, and view the camera feed from the ESP32 Cam module.The app will also contain the login module and sign up module.

2. Wi-Fi interface: The LED bulb must be able to connect to a Wi-Fi network to communicate with the smartphone app and transmit data to the cloud.

3. Camera interface: The ESP32 Cam module must be able to interface with the LED bulb circuitry and capture video data.

4. MicroSD card interface: The ESP32 Cam module may use a microSD card to store recorded video footage. The LED bulb circuitry must be able to interface with the microSD card and read/write data to it.

5. Power interface: The LED bulb must be designed to interface with a standard AC power socket and convert the AC power to DC power to power the LED and ESP32 Cam module. The power supply must be designed to provide sufficient power to run the LED bulb and ESP32 Cam module without overheating.

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Chapter 3

SYSTEM FEATURES

3.1 System Feature

3.1.1 Description and Priority

The LED Bulb with ESP32 Cam project is a unique combination of a traditional LED bulb and an ESP32 Cam module that adds additional functionality to the LED bulb. The project's main priority is to provide the user with a smart lighting system that can also capture video footage when needed.

The LED bulb control and camera feed display features are essential to the project as they allow the user to control the LED bulb's lighting and view the camera feed in real-time. The motion detection feature is also crucial as it triggers the camera to start recording when motion is detected, making the system more responsive and useful in detecting potential intruders or unusual activity.

The video recording feature is important as it allows the user to record footage from the camera module and store it on a microSD card. The cloud connectivity feature is optional but may be useful for users who want to access the camera feed and recorded video footage remotely.

3.1.2 Software Model

In the building of this software of LED Bulb we would be using the SDLC model named as Spiral model. The spiral model is a risk-driven process model. This SDLC model helps the group to adopt elements of one or more process models like a waterfall, incremental, waterfall, etc. The spiral technique is a combination of rapid prototyping and concurrency in design and development activities.
Each cycle in the spiral begins with the identification of objectives for that cycle, the different alternatives that are possible for achieving the goals, and the constraints that exist. This is the first quadrant of the cycle (upper-left quadrant).
The next step in the cycle is to evaluate these different alternatives based on the objectives and constraints. The focus of evaluation in this step is based on the risk perception for the project.
The next step is to develop strategies that solve uncertainties and risks. This step may involve activities such as benchmarking, simulation, and prototyping.

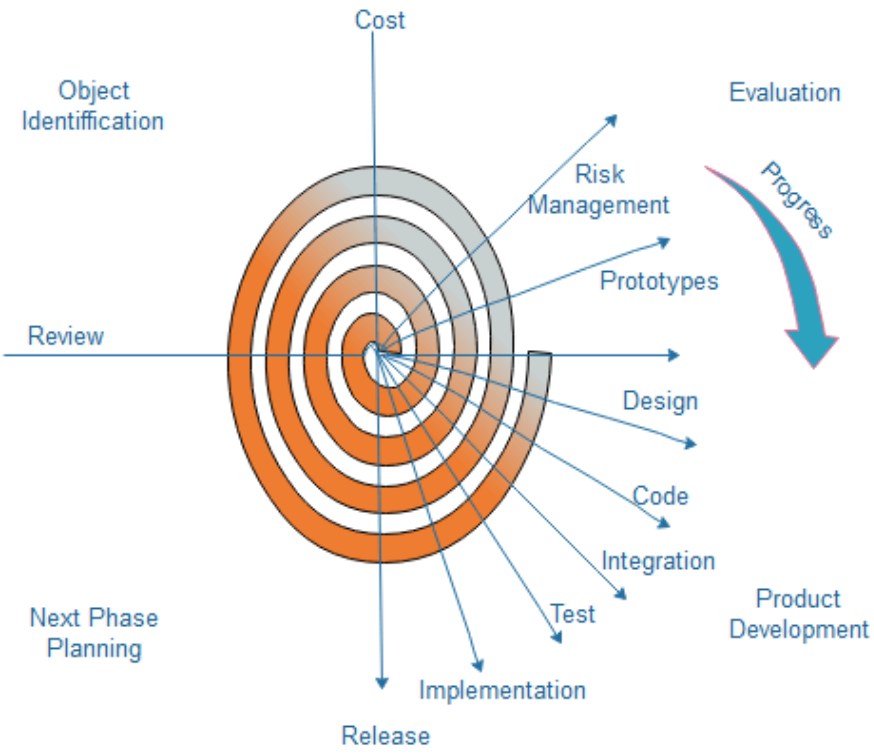

Figure 3.1: Spiral Model

3.1.3 Functional Requirements

- Camera Feed Display: The system should display the camera feed in real-time on the user's mobile application or web interface.
- Motion Detection: The system should detect motion and trigger the camera to start recording when motion is detected.
- Video Recording: The system should record video footage from the camera module and store it on a microSD card.
- Cloud Connectivity: The system should allow the user to access the camera feed and recorded video footage remotely using a cloud service.
- Firmware Update: The system should support over-the-air firmware updates to add new features or fix issues.
- Power Management: The system should have a mechanism to prevent overheating and ensure safe operation of the LED bulb and ESP32 Cam module.
- User Authentication: The system should require user authentication to prevent unauthorized access to the camera feed and recorded video footage.

Chapter 4

OTHER NON-FUNCTIONAL REQUIREMENTS

4.1 Performance Requirements

- Response Time: The system should respond to user inputs (such as changing the bulb brightness or color temperature) within 1 second.
- Camera Latency: The system should display the camera feed with a latency of no more than 500ms.
- Recording Quality: The system should record video footage with a resolution of at least 720p and a frame rate of at least 30fps.

4.2 Safety Requirements

- Electrical Safety: The LED bulb should be designed to meet relevant electrical safety standards to prevent electrical shock or fire hazards.
- Overheating Protection: The system should have a mechanism to prevent overheating of the LED bulb and ESP32 Cam module.
- User Safety: The system should be designed with user safety in mind, such as ensuring that the camera is not positioned in a way that violates privacy or creates safety hazards.

4.3 Software Quality Attributes

- Usability: The system should be easy to use and have an intuitive user interface for controlling the LED bulb and camera module.
- Reliability: The system should be reliable and able to operate continuously without failure or crashes.

- Security: The system should be designed with strong security measures to prevent unauthorized access to the camera feed and recorded video footage.
- Maintainability: The system should be designed to be easily maintainable, with clear documentation and support for firmware updates.
- Portability: The application should be portable i.e should be accessible on all windows devices.

Chapter 5

CIRCUIT DIAGRAMS

5.1 Flow Chart

1. The user presses a button on the LED bulb to initiate the video streaming process.
2. The Arduino Uno receives the button press signal and sends a request to the ESP32 cam module to start capturing the video stream.
3. The ESP32 cam module captures the video stream and sends it to the Arduino Uno for processing.
4. The Arduino Uno processes the video stream and sends it to the mobile app through Wi-Fi.
5. The mobile app displays the video stream on the user's smartphone.
6. The user can also control the on/off state and brightness level of the LED bulb through the mobile app.
7. The system continuously captures and streams the video until the user stops the streaming process or turns off the LED bulb.

This is a basic overview of the project's flow. The actual flow may differ based on the specific implementation details.

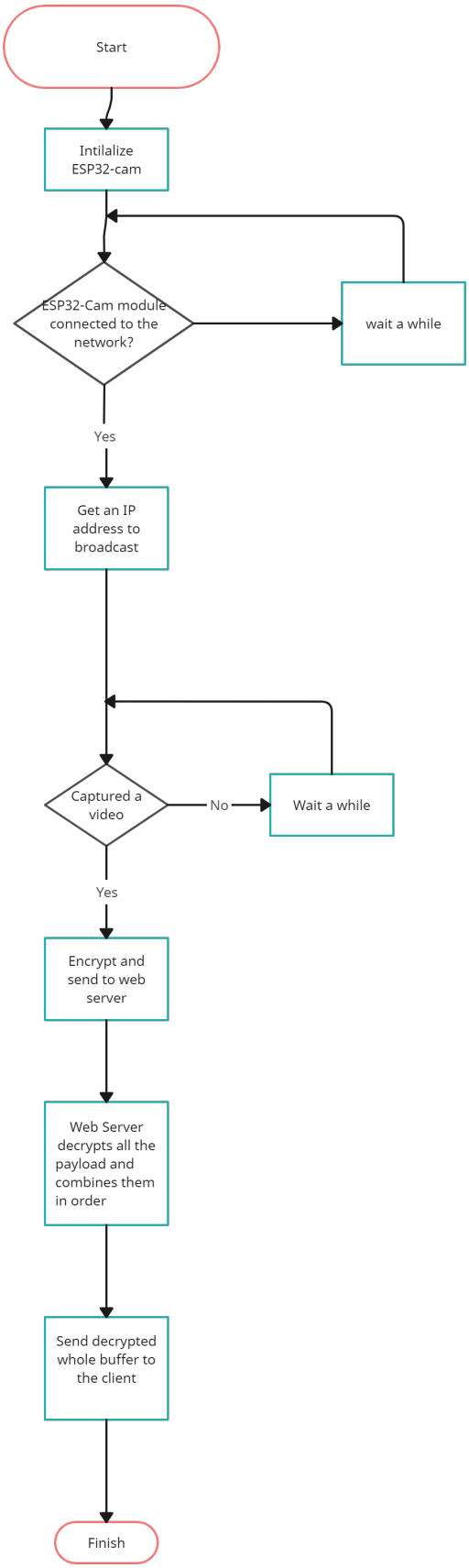

Figure 5.1: Flow diagram

5.2 Circuit diagram

In the circuit diagram we will include the ESP32 Cam module, which will be connected to the microcontroller. The microcontroller will be responsible for controlling the LED bulb and the ESP32 Cam module. It will also receive input from the user via a button, which will trigger the app to display the video stream from the camera.

The ESP32 Cam module will be responsible for capturing the video stream and transmitting it to the microcontroller for processing. The microcontroller will then use this information to determine the appropriate action for the LED bulb.

Overall, the circuit diagram of the LED bulb project will be designed to ensure that all components are connected correctly and operate efficiently. Proper testing and debugging of the circuit will be essential to ensure the successful operation of the LED bulb with spy camera functionality.

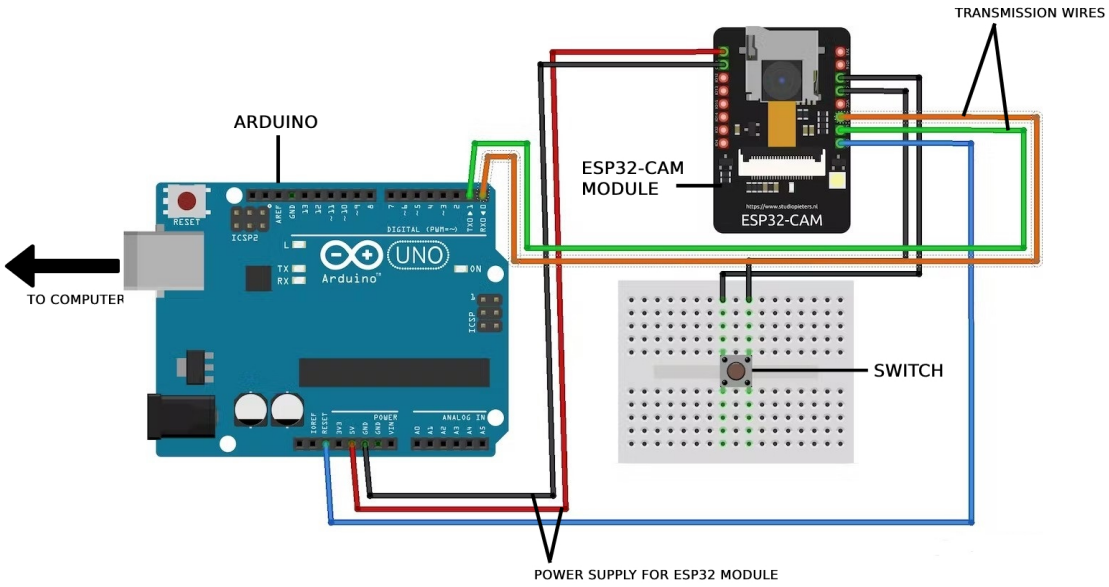

Figure 5.2: Circuit diagram

5.3 ESP32 camera module

The ESP32 Cam module is a critical component in the LED bulb project because it enables the spy camera functionality. The ESP32 Cam module is a compact camera module that is based on the ESP32 system-on-a-chip (SoC) from Espressif Systems. It features an OV2640 camera sensor, which has a maximum resolution of 1600 x 1200 pixels and can capture video at up to 60 frames per second.

The ESP32 Cam module is well-suited for this project because it is small, low-power, and easy to integrate with other hardware components. It also has built-in support for Wi-Fi connectivity, which allows it to communicate with other devices over the network.

In this project, the ESP32 Cam module is used to capture a video stream that can be accessed by

the user through a mobile app. When the user presses a button on the LED bulb, the microcontroller triggers the ESP32 Cam module to capture a video stream, which is then transmitted to the user's mobile device. This enables the user to monitor the environment in which the LED bulb is installed and to detect any unusual activity.

Overall, the ESP32 Cam module is a key component in the LED bulb project because it enables the spy camera functionality and enhances the security and surveillance capabilities of the LED bulb.

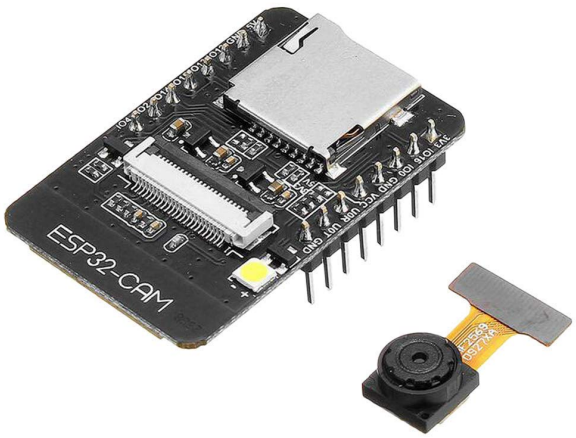

Figure 5.3: ESP32 Camera Module

5.4 ARDUINO UNO

In this project, the Arduino Uno serves as the microcontroller that controls the operation of the LED bulb and communicates with the ESP32 cam module. The functionality of the Arduino Uno includes:

- Controlling the LED bulb
- Communicating with the ESP32 cam module
- Processing data:
- Providing a user interface
- Handling system events

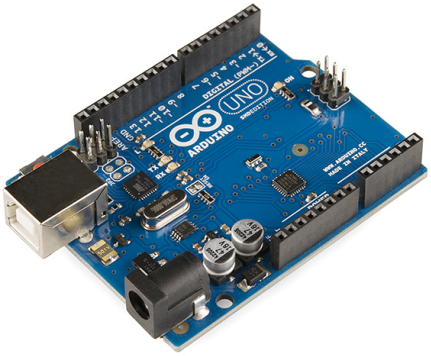

Figure 5.4: Arduino UNO

Chapter 6

REFERENCES

- https://dl.espressif.com/dl/package_esp32_index.json
- https://www.hackster.io/sainisagar7294/spy-anti-theft-camera-in-led-bulb-esp32cam-706e00
- https://esp32.com/viewtopic.php?t=28702
- https://forum.arduino.cc/