Project Brief
Product-based Capstone Project

LuminaSense

[Product Capstone]

Team ID	:	**C241-PS261**
Selected Themes/Case	:	Sustainable Futures: Nurturing harmony between humanity and ...
Mentor Name	:	**[Rinna Rachmatika],** [Done] (29-05-2024) **[Dessy Novita],** [Done] (07-06-2024)
Member Name	:	

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3. M308D4KY3170 – Willy Ahmadi – (ML) – [Active]
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BACKGROUNDER:

Electricity is a vital basic need in everyday life, especially in this modern era. According to data from BPS, around 40% of the total distributed electricity is used by households. In 2020, household electricity consumption reached approximately 111,4 GWh and increased to around 115,4 GWh in 2021.

However, not all household electricity is used efficiently, one example being the frequent neglect in turning off lights when they are not needed. To overcome this problem, we contributed by creating lights that can turn on and off automatically based on human presence. With this, there's no need to worry if someone forgot to turn off the lights. As a result, electricity can be saved.

Project Brief
Product-based Capstone Project

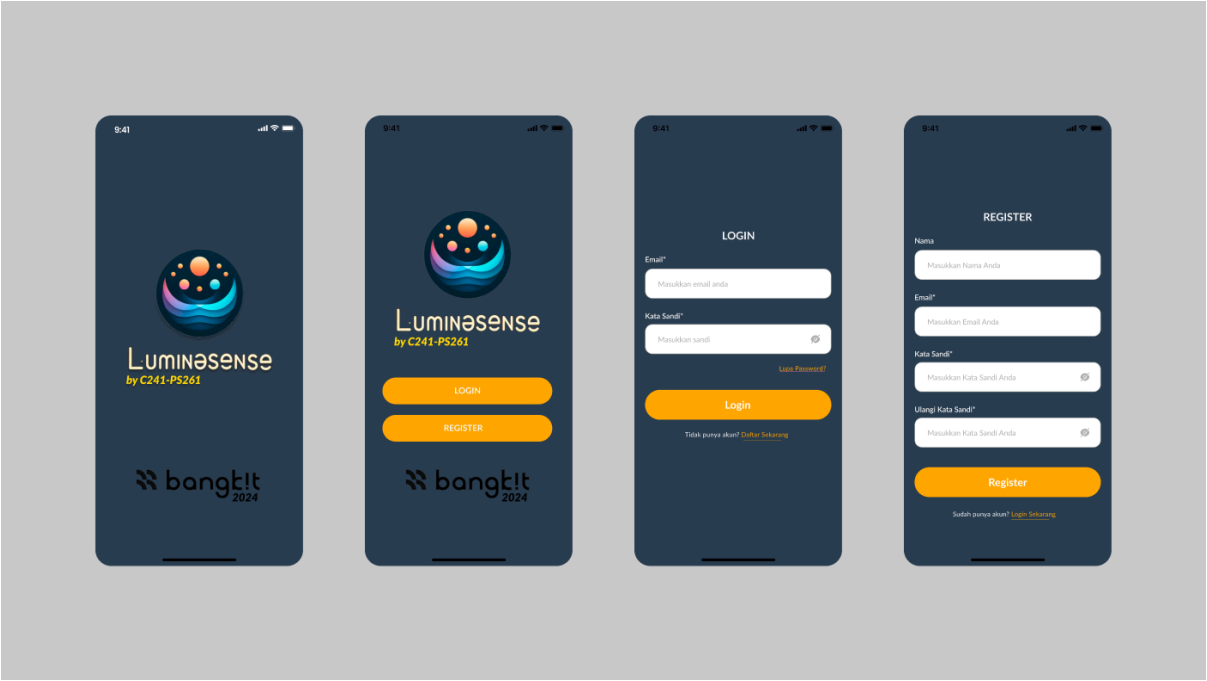
In terms of the specific contributions from each learning path:

1. Machine Learning: Collect and import image dataset from Kaggle, and annotate images with bounding boxes at Roboflow. Then build and train pre-trained machine learning model involving YOLOv8 in Google Colab. Then convert the model in TFLite format to be deployed by the MD team.
2. Mobile Development: We utilized Android Studio and Kotlin to create a robust Android app. We prioritized a user-friendly experience, enabling access to live camera feeds from ESP32Cam with real-time human presence detection, enhancing utility and relevance for users.
3. Cloud Computing: We utilize Google Cloud Platform (GCP) as our primary infrastructure, employing Visual Studio Code for programming and Postman for API testing. To deploy our Backend and ML models, we implement serverless approaches such as App Engine or Cloud Run. Additionally, we utilize the Hapi.js framework, based on Node.js, for building the application's Backend.

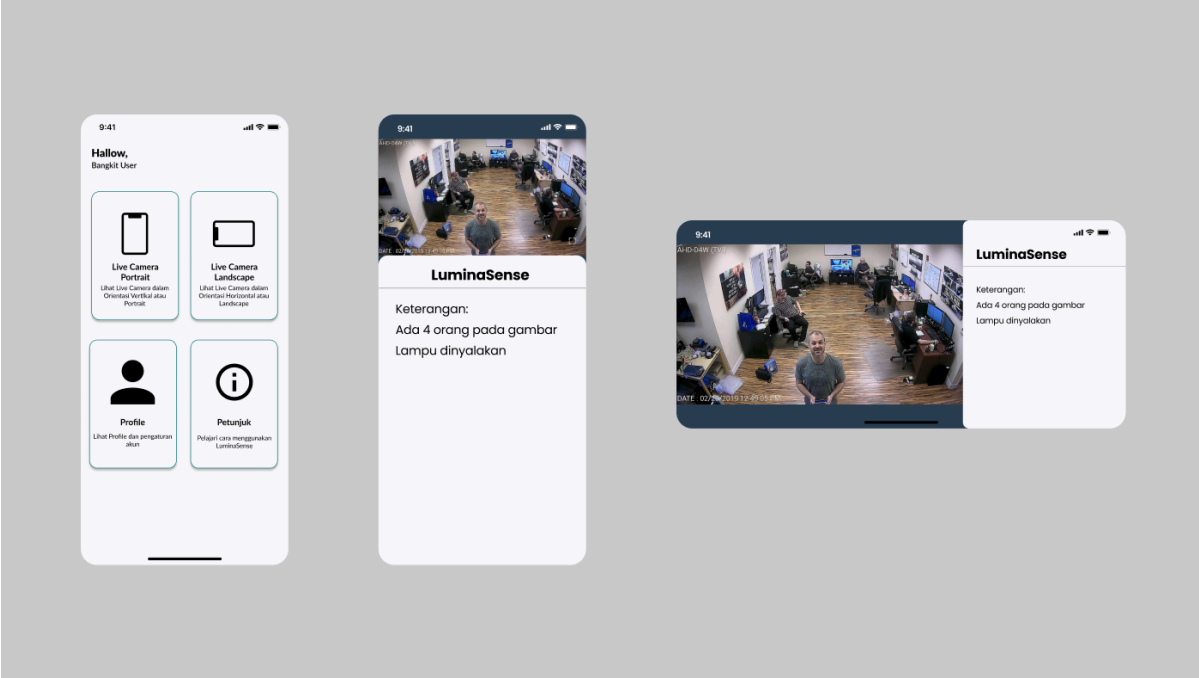
PROJECT STATUS :

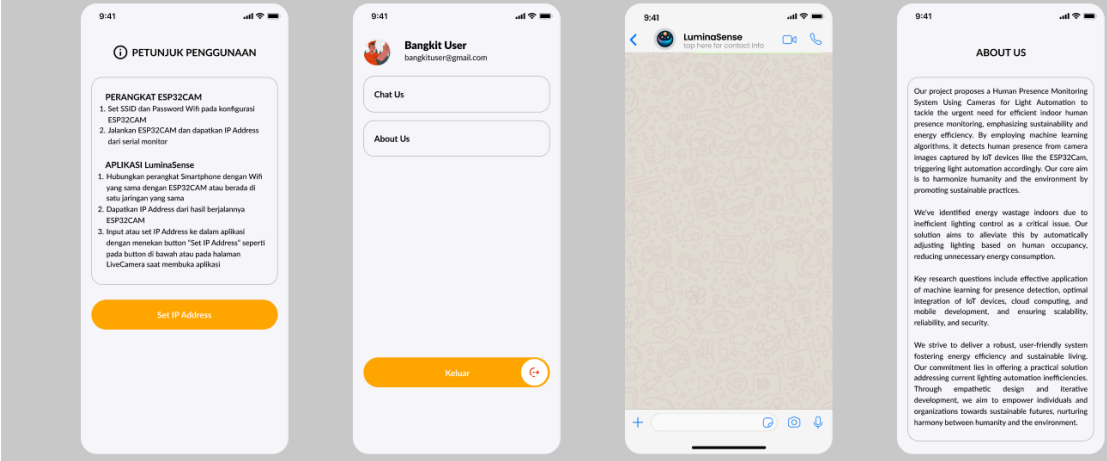
>75% Project Plan Completed

SCREENSHOTS/DEMO VIDEO:



Project Brief
Product-based Capstone Project





Project Brief
Product-based Capstone Project

VIDEO DEMO LINK:
https://youtu.be/zYiAqlTSgfg

DATASET LINK:
https://universe.roboflow.com/capstone-luminasense/human-detection-nz0aq/browse?queryText=&pageSize=50&startingIndex=0&browseQuery=true

DEPLOYED LINK:

- Model-Machine-Learning: https://colab.research.google.com/drive/1R60vg2OPDlumvQ3LzZDnzvA247zoFe1M?usp=sharing
- Backend Deployed Link: https://lumina-sense-sgithgzkka-et.a.run.app/

GITHUB REPO LINK:
https://github.com/C241-PS261-LuminaSense

10-MIN VIDEO PRESENTATION LINK:
https://youtu.be/pvTz_XqPn4U

SLIDE PRESENTATION LINK:
https://drive.google.com/file/d/15Ta5DG0wvzPQeLSUr6eVzm96jCPiXVhZ/view?usp=sharing

GO-TO-MARKET PROPOSAL LINK :
https://drive.google.com/file/d/1ibLzQyT3r1gM2zFP-O4GimKnxn9iFctq/view?usp=sharing

GO-TO-MARKET PROPOSAL

a. **TARGET MARKET**

Age Range	Profession	Roles	Hobbies
	Homeowners, Property Managers, Engineers	Tech Enthusiasts, Eco-conscious Consumers	Smart home technology, Sustainability, Energy saving
	Office Managers, Retail Managers	Business Owners	Enhancing customer

Project Brief
Product-based Capstone Project

20+ years old			experience, Reducing operational costs
	Facility Managers, Healthcare Admins	Efficiency Seekers	Optimizing energy usage, Improving operational efficiency
	Factory Supervisors, Warehouse Managers	Industrial Operators	Efficient lighting management, Cost reduction

Our Human Presence Monitoring System (LuminaSense) Using Cameras for Light Automation meets the diverse needs of multiple target markets by enhancing sustainability and energy efficiency. Homeowners, property managers, and engineers benefit from reduced utility bills and a smaller carbon footprint. Office and retail managers can cut operational costs and improve sustainability, enhancing customer experiences. Facility managers and healthcare administrators achieve significant energy savings and operational efficiency, essential for 24/7 operations. Government officials and educators fulfill sustainability mandates and reduce costs, demonstrating environmental stewardship. Finally, factory supervisors and warehouse managers optimize lighting usage, significantly lowering electricity expenses and improving overall sustainability.

1. Purpose-driven
   Our Human Presence Monitoring System (LuminaSense) Using Cameras for Light Automation is purpose-driven to enhance efficiency and sustainability across diverse sectors. By intelligently managing lighting based on real-time occupancy data captured through cameras, our solution aims to:
   - Reduce Energy Consumption: By ensuring lights are only active when spaces are occupied, we minimize unnecessary energy usage, contributing directly to lower utility bills and a reduced carbon footprint.
   - Enhance Operational Efficiency: Whether in homes, offices, healthcare facilities, government buildings, or industrial settings,

Project Brief
Product-based Capstone Project

optimized lighting management leads to streamlined operations, improved productivity, and enhanced comfort for occupants.

2. Data-driven
   Our system leverages advanced data analytics from camera feeds to drive decision-making and operational improvements:
   - Real-time Occupancy Insights: Continuous monitoring of occupancy patterns provides actionable data to adjust lighting settings dynamically, ensuring optimal energy use without compromising safety or comfort.
   - Performance Metrics: Quantitative data on energy savings, operational efficiencies, and environmental impact metrics are meticulously tracked and analyzed. This enables stakeholders to make informed decisions and validate the effectiveness of our solution.

3. Government Reasoning
   Our solution resonates strongly with government entities and policymakers:
   - Compliance with Regulations: By deploying our system, government buildings can adhere to stringent energy efficiency regulations and sustainability mandates. This ensures alignment with national and international standards for environmental stewardship.
   - Cost Savings for Public Budgets: Reduced energy consumption translates into significant cost savings for public sector budgets. This frees up resources for other critical infrastructure improvements and public services.
   - Demonstrable ROI: Clear return on investment through reduced energy expenditures and operational efficiencies strengthens the case for public funding and investment in sustainable technologies.

4. Stakeholders related to and benefitted from your solutions
   Our Human Presence Monitoring System(LuminaSense) benefits a wide array of stakeholders:
   - Building Owners and Managers: Enhance property value through improved energy efficiency and operational savings.

Project Brief
Product-based Capstone Project

- Facility Managers: Simplify operations with automated lighting controls that adapt to real-time occupancy data.
- Business Owners: Lower operating costs and enhance workplace productivity through optimized lighting solutions.
- Government Officials: Achieve sustainability goals while demonstrating leadership in environmental conservation.
- End Users (Employees, Residents, Patients): Enjoy enhanced comfort and safety with lighting tailored to occupancy, promoting a pleasant environment.

b. MARKETING STRATEGY

1. Market Segmentation

- Property Owners and Facility Managers: Energy efficiency and cost reduction.
- Business Owners and Office Managers: Productivity and comfort.
- Factory and Warehouse Managers: Energy cost reduction and sustainability.

2. Product Offering

- Advanced Technology: Optimizes lighting based on presence.
- Easy Integration: Compatible with existing infrastructure.

3. Market Penetration

- Educational Campaigns: Webinars, seminars, and marketing materials.
- Trial Offers: Free trials or demos.
- Strategic Partnerships: Collaborations with energy service providers and system integrators.

4. Promotion and Sales

- Digital Campaigns: SEO, PPC, social media.
- Industry Events: Trade shows, conferences.
- Special Promotions: Discounts and bundled.

c. COMPARISON WITH SIMILAR SERVICE/APPS (if any)

- Similarity percentage

  30%

Project Brief
Product-based Capstone Project

- Analysis of the different or unique
  LuminaSense offers a memory-efficient solution that still provides an advanced and responsive lighting automation experience, unlike Bardi which may have a broader range of features but uses more memory.

d. Sustainability: Profit Projection per Year

Format

No	Description	Total
INCOME		
1	Cash	Rp500.000.000
2	Sales (penjualan)	Rp300.000.000
3	Project (proyek)	Rp150.000.000
4	Subscription (langganan)	Rp 50.000.000
5	Grants (hibah)	Rp 20.000.000
6	Soft Loan (pinjaman)	Rp 200.000.000
	Total Income (A)	**1.220.000.000**
EXPENSES		
A	**Additional Budget for Team Salary**	
1	Detail 1	Rp30.000.000
2	Detail 2	Rp20.000.000
B	**Additional Budget for Research/Ops**	
3	Detail 1	Rp40.000.000
4	Detail 2	Rp35.000.000
C	**Marketing and Sales**	
5	Detail 1	Rp15.000.000
6	Detail 2	Rp15.000.000
	Total Expenses (B)	**150,000,000**
	Total Revenue (A-B)	**480,000,000**

Project Brief
Product-based Capstone Project

e. **SWOT Analysis of the project**

- **Strengths**
  In terms of energy efficiency, the LuminaSense app automates the lights by detecting human presence, so the lights only turn on when needed. This helps reduce energy waste.
- **Weaknesses**
  There are problems if there is a network connection problem because the ESPCam32 camera is connected to WiFi. Apart from that, the camera's range of capturing objects in a room can be limited (blind spot), depending on the position of the camera
- **Opportunities**
  The growth of the smart home market opens up opportunities for integration and use of this technology in various household applications. Additionally, more and more people are becoming aware of the importance of energy efficiency, creating huge opportunities for the adoption of this technology.
- **Threats**
  The large number of similar products on the market can increase competition and reduce prices.

MENTORING REMARK(S), IF ANY:
Put remarks from your mentoring, if any.

On May 29, 2024, we conducted business mentoring to develop a human presence monitoring system using cameras for light automation. Utilizing the Business Model Canvas (BMC), we designed a comprehensive business strategy, leveraging data from reputable sources to explain the project's background. This approach helps highlight the product's advantages, including energy efficiency and user convenience, by comparing it to the weaknesses of similar products already on the market.

On June 7, 2024, we met with a machine learning mentor to refine our capstone idea in detail with sketches. We used bounding boxes to ensure the model can accurately classify objects. Additionally, we added a dataset and ensured the total number of images for both labels is not significantly different.

Project Brief
Product-based Capstone Project

Did the implemented capstone project differ from the original plan, and if so, how did these changes impact the project's success and outcomes?

Originally, we planned to use the MobileNetV2 model for image classification. However, midway through, we realized that our focus on image classification with MobileNetV2 didn't match the project's objective, which was actually object detection. Recognizing this mismatch, we shifted our approach and attempted to implement the YOLOv8 model for custom object detection. Despite this change requiring adjustments in methodology and training processes, it ultimately led us to a solution better suited to our project's needs, thereby enhancing our implementation effectiveness.