HW_4_Written_Document_Embedded_System

Question 1) Explain how the light level sensor is being calculated to determine if the light level is high, medium, low, or non-existent.

Answer 1) A photocell or the light sensor is a variable resistor which adjusts its resistance on the amount of light it receives, its is a semiconductor, within them they have energy bands, valence bands for the lowest energy and conduction band for the highest energy with an energy gap in between those bands, when the light hits the photocell the photons excite the electrons from the valence bands cross the energy gap to go the conduction band, dropping the resistor of the photoresistor allowing more energy to flow within, the more number of electrons going into the conduction bands means least resistance in the circuit resulting in Higher reading.

The operation of a photocell, or light-dependent resistor (LDR), relies on its ability to change resistance based on the intensity of incident light. When light strikes the photocell, its resistance decreases due to the photoelectric effect, which enhances electron activity and conductivity. In a typical circuit, this change in resistance is measured using a voltage divider, where the sensor's output is inversely proportional to the photocell's resistance. As light intensity increases, the reduced resistance causes a higher voltage drop across a fixed resistor, leading to a higher sensor reading. Conversely, in low light conditions, the resistance is higher, resulting in lower readings. These changes in sensor readings are then used to detect and respond to variations in light levels, such as dimming lights in bright environments or activating them in darkness. This interplay between resistance, sensor output, and light intensity is fundamental to light-sensing applications.

Question 2) Envision a situation in which a light sensor would make a good tool and describe how the sensor circuit and software could be modified to address the situation.

Answer 2) In an Automated Lights Hub setup, light sensors can be strategically placed, such as on rooftops or near windows, to capture the maximum amount of sunlight. These sensors monitor the ambient light intensity and, when it falls below a certain threshold, automatically activate the indoor lighting system. To enhance efficiency and ensure lights are only used when necessary, the system can integrate motion sensors or heat sensors that detect human presence. This combination enables the system to turn on lights only in areas where both low light and human activity are detected, conserving energy when rooms are unoccupied. The sensor circuit would be designed to include a light sensor connected to a microcontroller to measure light intensity and compare it against a pre-set threshold. Motion or heat sensors would also feed data into the microcontroller, which processes all inputs to decide whether to switch the lights on or off via relay modules. Software enhancements can include timers to keep lights on for a defined duration after movement is detected or allow user-configured thresholds for personalized settings. The system could also be connected to a central hub, making it not only energy-efficient but also convenient. This integrated approach ensures that lighting is automatically adjusted to the environment and occupancy, reducing electricity wastage and offering a seamless, smart lighting experience.