

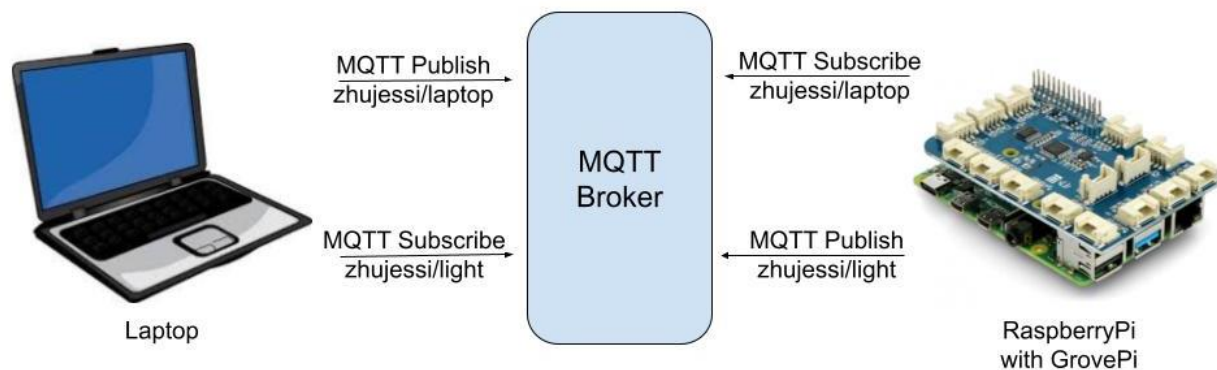
## Project Writeup

### System Description:

In this IoT system, a smart window blinds system was created to inform the user of whether to open or close their window blinds depending on the brightness inside and outside the building.

For detection of brightness inside the building or room, a GrovePi light sensor was used. For detection of brightness outside, a weather API was used to pull relevant information such as whether it is day or night time, current cloud coverage, and current visibility. By comparing the brightness inside and outside the room, the LCD screen connected to the GrovePi would display a message to either open or close the blinds.

### Block Diagram:



### Implementation:

This project uses 2 nodes: the laptop and the RaspberryPi (RPi). The RPi is also connected to a GrovePi with a GrovePi light sensor and LCD RGB attached. As shown in the block diagram above, the nodes exchange information using the MQTT protocol with each node being a publisher and subscriber of the other. Since the USC Eclipse broker was not available, the public Eclipse Mosquitto broker (<https://test.mosquitto.org/>) was used. Additionally, a weather API (<https://www.weatherapi.com/>) was used by the laptop to retrieve relevant weather information. The RPi retrieved values from the GrovePi light sensor as well as displayed messages on the LCD RGB.

In the laptop.py file, the laptop retrieved 3 pieces of information from the weather API — cloud coverage, visibility, and whether it was day or night. This data was then processed using a weighted averaging technique. First, day or night status trumped everything since blinds should logically be closed during the night and only potentially opened during the day. If it was day, then cloud coverage and visibility were weighted, with cloud coverage weighted much more heavily, to compute an outside brightness percentage. This is because cloud coverage is a much more important factor in determining outdoor brightness as compared to visibility. In the rpi.py file, the RPi sampled sensor values from the GrovePi light sensor and published them to the laptop via the zhujessi/light topic. Being subscribed to this topic, the laptop used these

sensor values to compute an inside brightness percentage. Then, the outside and inside brightness percentages were compared. If it was day time, and the inside was brighter, then the close blinds message was published to the RPi via the zhujessi/laptop topic; however, if the outside was brighter, then the open blinds message was published. With the RPi subscribed to this topic, it would display the proper message accordingly on the RGB LCD.

Finally, a visualization element was included on the laptop in the form of a plot that showed the 10 most recent light sensor readings. Since readings were taken every 2 seconds, the plot would be updated accordingly.

#### Reflection:

One of the more challenging aspects of this project was setting up the communication between nodes using MQTT. Both nodes had to be publishers and subscribers so that communication could go smoothly both ways. Another challenging was figuring out the best way to determine brightness inside and outside as well as being able to compare them properly. Some research into factors that affect outdoor brightness was done, and it took some work trying to extract only the necessary factors from the weather API. Additionally, some testing had to be conducted to find appropriate weights for the information retrieved from the API. Finally, a method to standardize the inside and outside brightness levels as numeric values had to be created in order to properly compare the 2. The simplest way was to compute brightness level as a percentage out of 100.

The limitations of the project mainly involve accuracy. First, the GrovePi light sensor is not very accurate and doesn't have the best sensitivity to light. This affected the computed brightness level inside the building. Second, the data processing of the information from the weather API could be more accurate as only 2 factors were used and the weights of them were approximated. This affected the computed brightness level outside the building. Thus, by comparing 2 somewhat inaccurate values, the result of opening or closing blinds has a high potential of also being inaccurate.