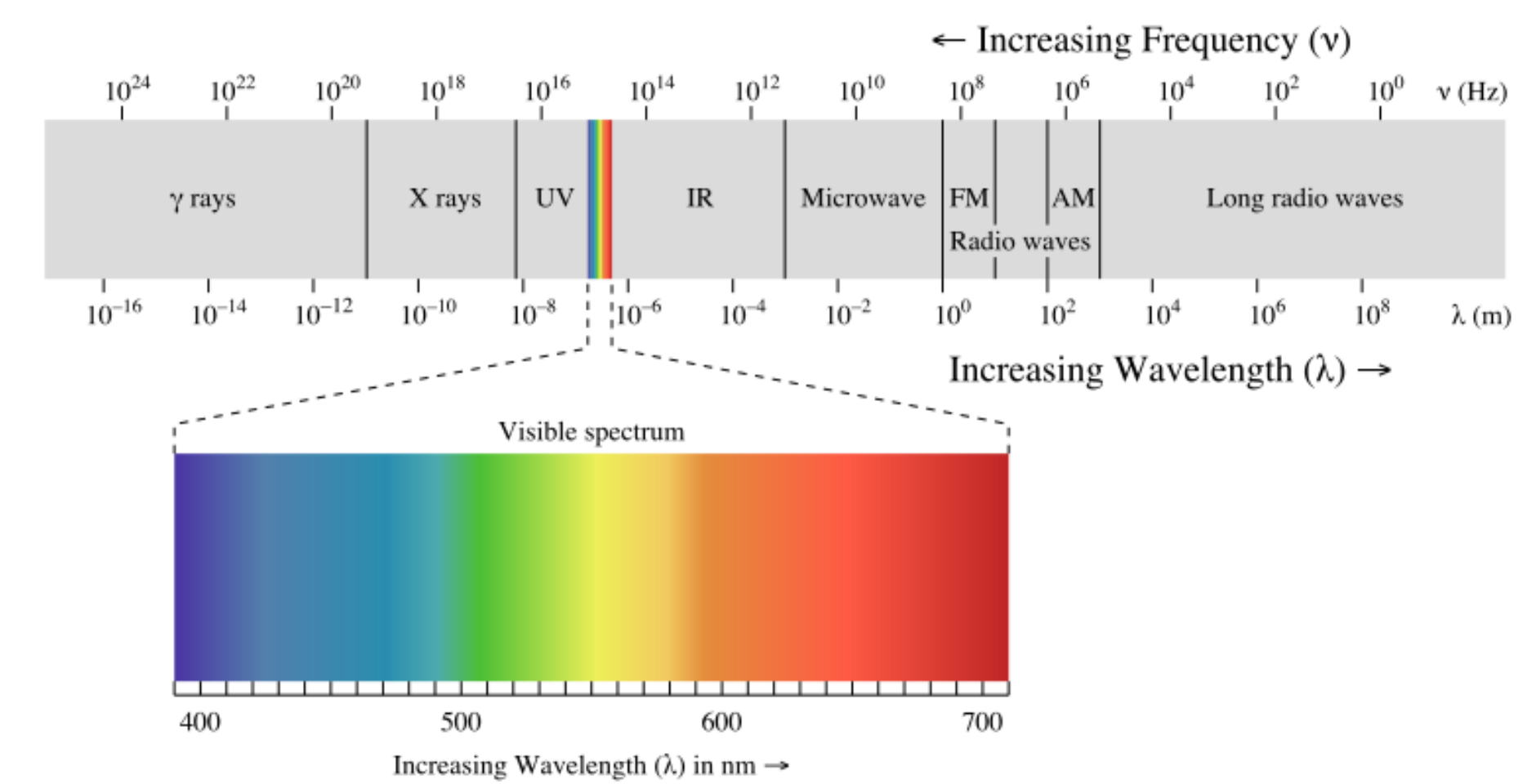


# Visible Light Communication

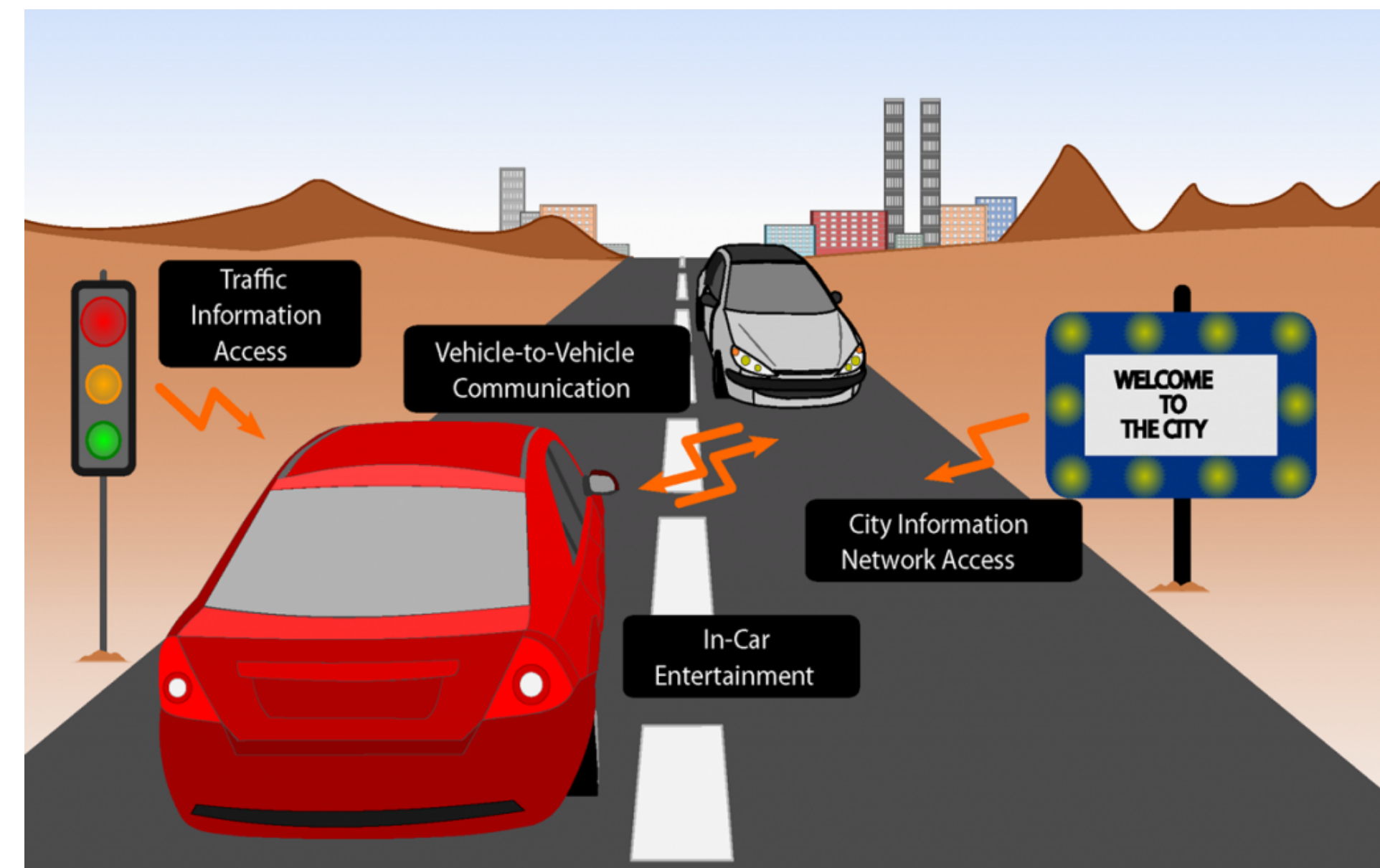
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## INTRODUCTION

Visible light is a small portion portion of electromagnetic spectrum, it has frequencies of about 400 THz to 800 THz and wavelength of about 780 nm to 375 nm.

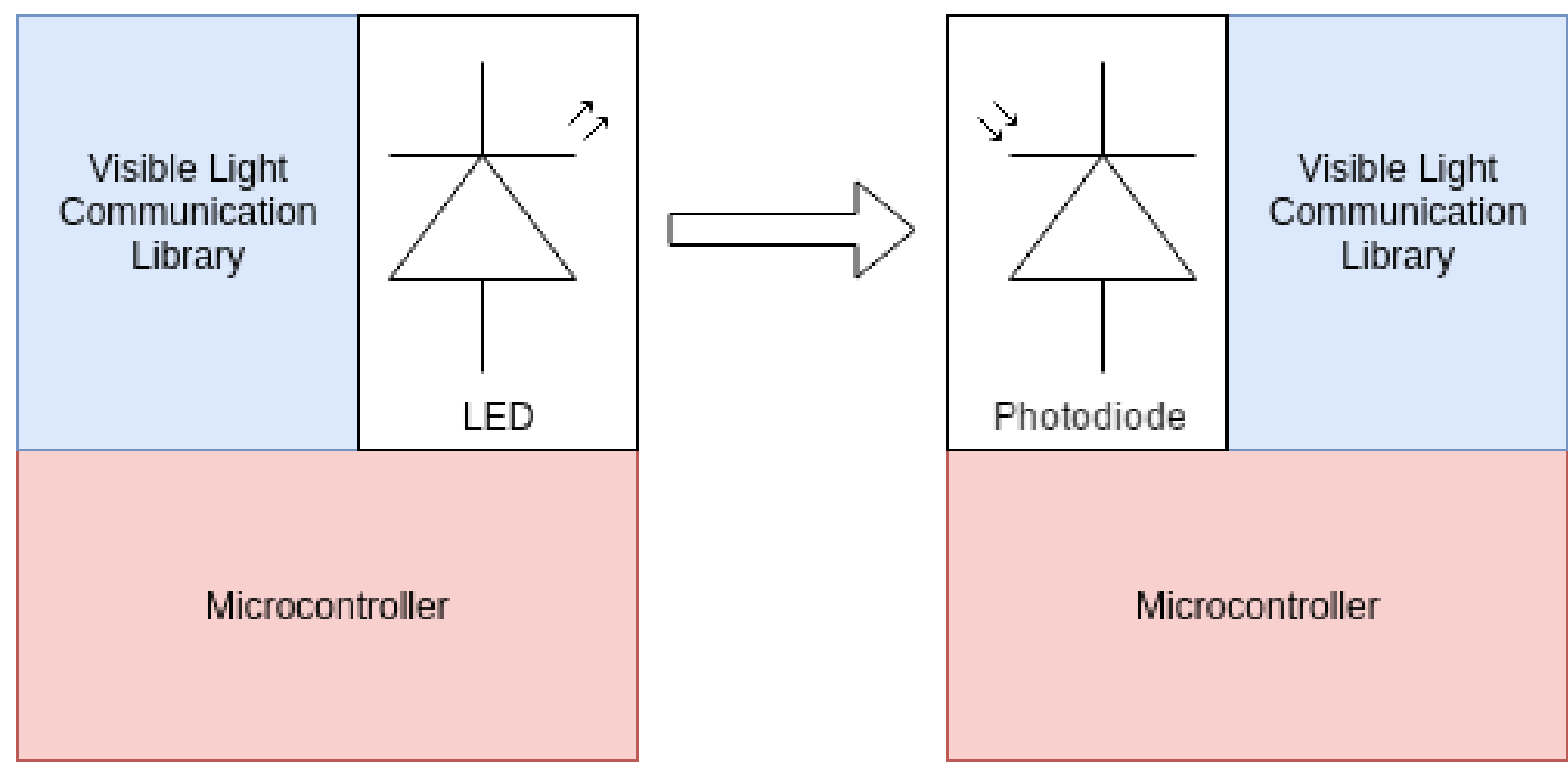


Visible Light Communication can be used as a communications medium for ubiquitous computing, because light-producing devices such as indoor/outdoor lamps, TVs, traffic signs, commercial displays and car headlights/taillights are used everywhere.



Car to Car Communication using Visible Light

Visible Light Communication can be achieved simply using a LED and a photodiode:



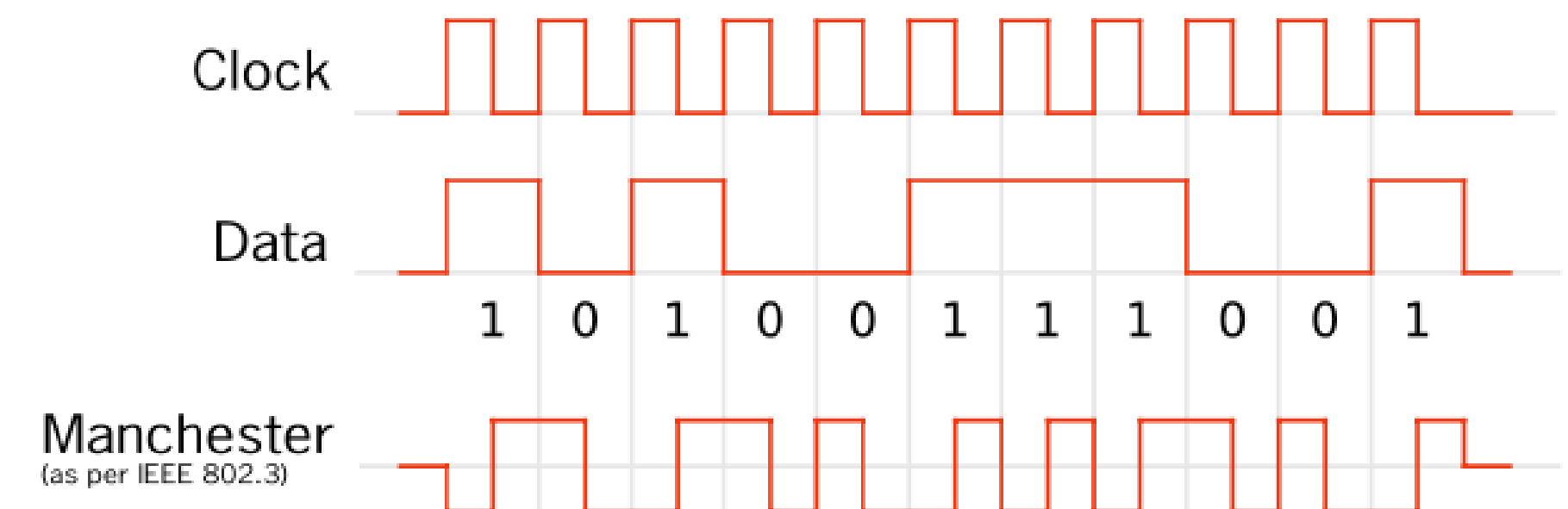
The main motivation of the project is to develop a Visible Light Communication library and develop a sample application to demonstrate the usage of the library.

## METHOD

There are two sides of the communication: transmitter and receiver.

### Transmitter

In the Visible Light Communication library, the data to send is encoded with Manchester coding. Because in Manchester coding, each data bit is either low then high, or high then low, of equal time. So, it does not affect the perceived lighting and the LED appears to be high all the



An example of Manchester encoding. The logic 0 is represented by a high-low signal sequence and the logic 1 represented by a low-high signal sequence.

On the transmitter side, STX (start of text from the ASCII table) is added at the beginning of the message and ETX (end of text from the ASCII table) is added at the end of the message. Then, the message is encoded using Manchester encoding and is transmitted using a LED.

STX	Data	ETX
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Frame format

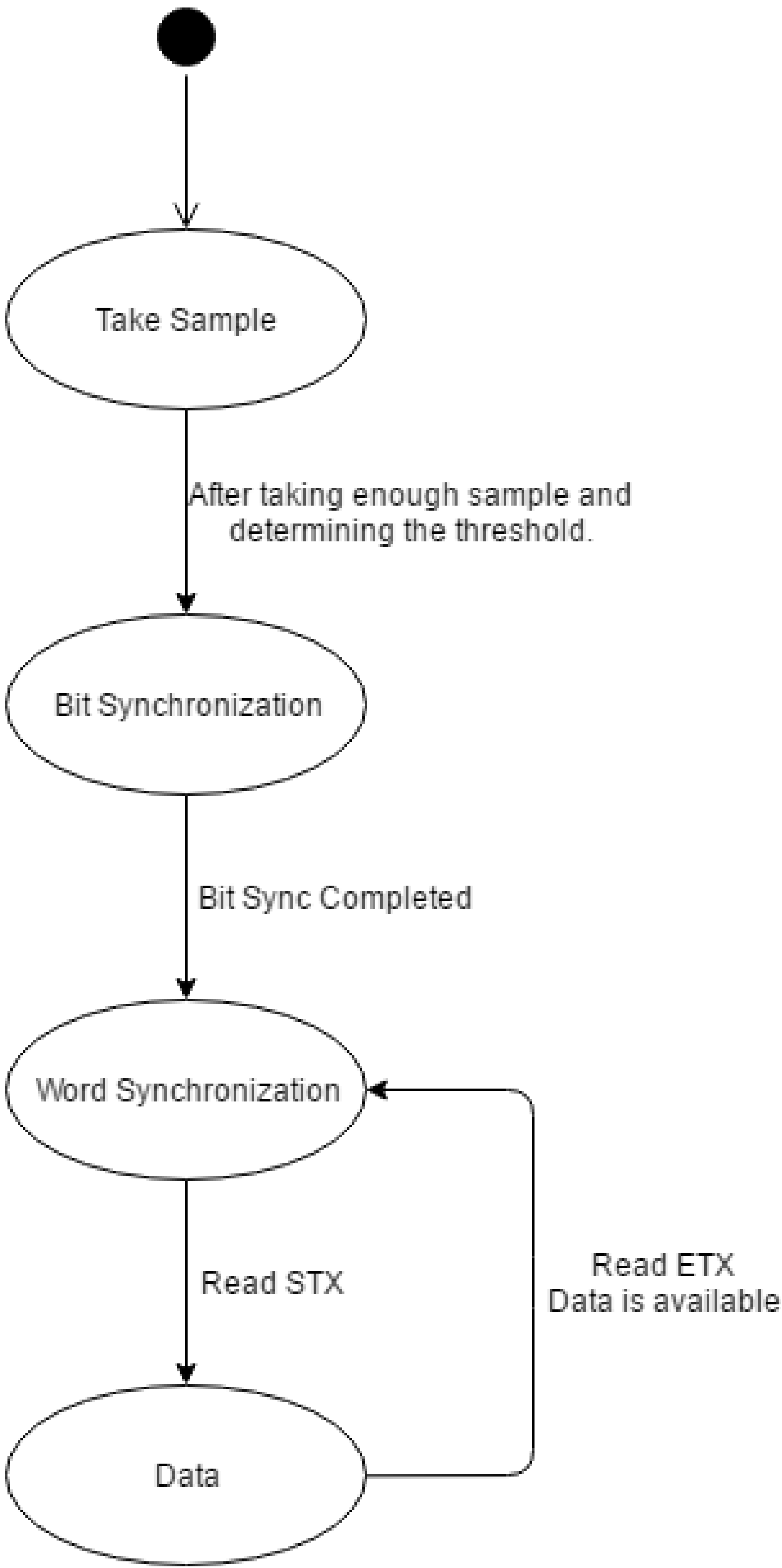
### Receiver

A finite-state machine was used to simply the code and make the code maintainable. Figure 2.3 shows the state diagram of the logic of the receiver side.

In "Take Sample" state, the receiver takes samples to determine the threshold. The amount of the samples is dependent on the baud rate. For example, it takes 400 samples at 2000 bauds.

One bit is represented by two signals, either high-low or low-high, in Manchester coding. The receiver determines bit position in "Bit Synchronization" state with waiting for two identical signals (low-low or high-high).

After "Bit Synchronization" state, the receiver waits for STX byte, which is 0x02 in ASCII table, in "Word Synchronization" state. After that, it reads the data byte by byte until reading ETX byte which is 0x03 in ASCII table.



State diagram of the receiver logic

## RESULTS

In Visible Light Communication, there is a trade-off between speed, distance and consistency. For example, if consistency is not much important, speed and distance can be increased. In our approach, consistency was tried to be maximized. The results for a standard LED and a 1W LED are following:  
Standard LED:  
speed ~1 kbit/sec, distance ~5 cm  
speed ~10 kbit/sec, distance ~2 cm  
1W Power LED:  
speed ~1 kbit/sec, distance ~10 cm  
speed ~2 kbit/sec, distance ~6 cm

## CONCLUSIONS

It is concluded that the Visible Light Communication technology can be implemented as an alternative compared to other wireless transmission technologies. Visual light provides several opportunities to apply visible light communications as light in the visible spectrum is used everywhere. Many applications could be done in this field that will be certainly useful like medical, health application and sound transmission.



Indoor Location-Based Services Using LED Lighting from General Electrics