Review Comments:

Reviewer: 2

Recommendation: Review Again After Resubmission (Paper is not acceptable in its current form, but has merit. A major rewrite is required. Author should be encouraged to resubmit a rewritten version after the changes suggested in the Comments section have been completed.)

Comments:
This work proposes a flow of image compression containing various steps that can be used in IoT applications. Machine learning is also involved in the flow. Besides, the corresponding hardware design is introduced for the proposed flow. The results show that the proposed hardware design can achieve a speed at 50 frames per second, with reasonable area consumption. The work is complete, with both algorithm and hardware design. However, there are some places not clear enough, which are listed below:

Response for Reviewer 2.

We appreciate the reviewer for providing many constructive comments and valuable suggestions, which have helped us to improve the manuscript. The responses and corrections are explained after each comment.

Q1. For Sections 2.2 and 2.3, it seems that the algorithms are not newly proposed by this paper, so it is better to shrink the description.
Response: We thank for the reviewer's comment. Excessive introductions in sections 2.2 and 2.3 can easily dilute the study's emphasis. In the amended version, we have shortened the description of sections 2.2 and 2.3. Sections 2.2 and 2.3 of the manuscript have been edited and expanded on pages 5 and 6. The revised text is as follows: 1.*Section 2.2* *The BTC algorithm [21] has a lower complexity than the traditional BTC or AMBTC algorithm, which can save hardware costs. In view of this, this research proposes a more advanced threshold optimization, the BTC algorithm. This method do not only maintain the image compression rate, but also improves the image quality. A bitmap is a binary information. The threshold in the traditional BTC algorithm is the average of the blocks utilized.* *When the current pixel value is greater than the average value, and the distance between the reconstructed value a and the current pixel value are less than the reconstructed value b, the current pixel value is considered to be the high reconstructed value b. Although, the original pixel is closer to the low reconstructed value a. Since the decoded value of the pixel depends on the threshold, selecting an appropriate threshold for decompression is important. This*

method can effectively improve the PSNR of the image without affecting the compression rate. Therefore, the improved formula based on the research in [22] is shown in Equation (6):

2.Section 2.3

The two reconstruction value procedures of BTC employed in this research are shown in Equations (7) and (8). The calculation of threshold optimization complexity is reduced, but without the standard deviation it cannot maintain the high performance of image quality. In order to improve this problem, the variable parameters α1 and α2 will enable the algorithm to calculate the best reconstruction value to compensate for the image quality. The machine learning adjest and train the parameters α1 and α2 are variable values from 0 to 1. Each cycle will increase by 0.25 and the current two reconstruction values are calculated for each iteration.

Q2. It is mentioned that machine learning is used for BTC, but there is no place explicitly mentioned how the machine learning is used. Is Section 2.3 the place?

Response:

We thank for the reviewer's comment. After careful examination, the machine learning portion of the manuscript is indeed less, which may cause confusion among readers. We have included a discussion of this aspect in the description of BTC and changed the description of machine learning in section 2.3 on page 6 of the manuscript. The revised text is as follows:

The two reconstruction value procedures of BTC employed in this research are shown in Equations (7) and (8). The calculation of threshold optimization complexity is reduced, but without the standard deviation it cannot maintain the high performance of image quality. In order to improve this problem, the variable parameters α1 and α2 will enable the algorithm to calculate the best reconstruction value to compensate for the image quality. The machine learning adjest and train the parameters α1 and α2 are variable values from 0 to 1. Each cycle will increase by 0.25 and the current two reconstruction values are calculated for each iteration.

Q3. In Section 2.4, "BTC training" is mentioned without definition before. Please clarify this.

Response:

We thank for the reviewer's comment. We sincerely apologize for the section where the nouns are not unified. We replaced "parameter training" in the text with "BTC training" after detailed evaluation. Pages 4 and 6 have been updated with new text.

1. *Figure 1 depicts the flowchart of the compression method developed in this study. First, the original image in RGB color space is converted to YEF color space and is sampled to 4:2:0 format to the E and F color spaces afterwards. Second, in order to determine the*

*two ideal reconstruction values and bitmap for each 4*4 block, a BTC training is then carried out. Third, the E and F color spaces are sampled to a 4:2:2 format. Fourth, the reconstructed values are subtracted to obtain the predicted symbol. Finally, Golomb-Rice coding is quantized based on the quantization table.*

2. *2.3 BTC training*

   The two reconstruction value procedures of BTC employed in this research are shown in Equations (7) and (8). The calculation of threshold optimization complexity is reduced, but without the standard deviation it cannot maintain the high performance of image quality. In order to improve this problem, the variable parameters α1 and α2 will enable the algorithm to calculate the best reconstruction value to compensate for the image quality. The machine learning adjest and train the parameters α1 and α2 are variable values from 0 to 1. Each cycle will increase by 0.25 and the current two reconstruction values are calculated for each iteration.

Q4. Is the Figure 9 the "BTC training" module in Figure 8? If so, please clarify this in the paper. If not, where is the module of Figure 9 in the overall hardware architecture?

Response:

We thank for the reviewer's comment. Figure 9 is the "BTC training" module in Figure 8. We have modified the description "The architecture of the bitmap Generator module" to "The architecture of the BTC Training module" in Figure 9 on page 10.

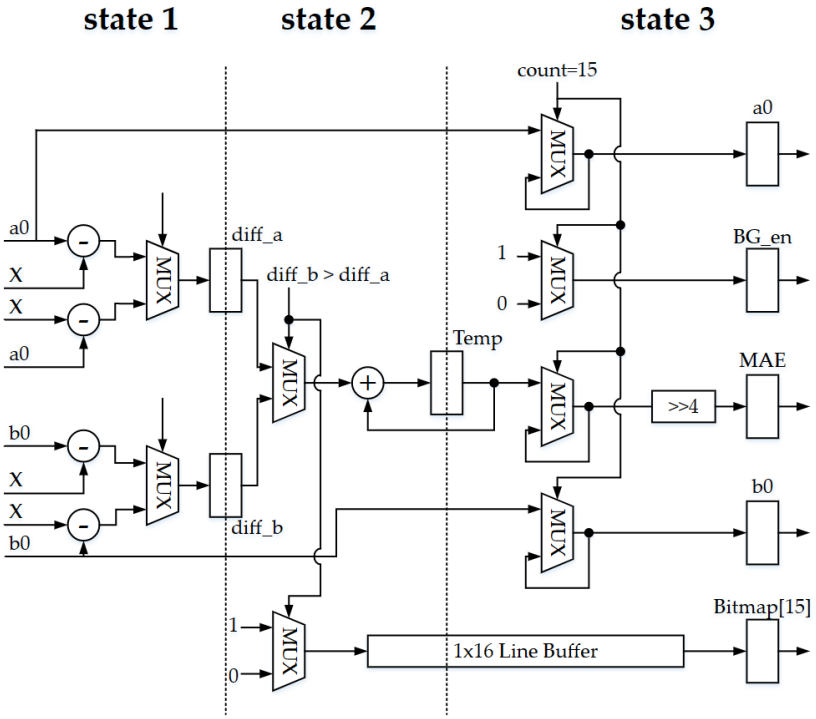


Figure 9. The architecture of the BTC Training module.

Q5. In the experiment, the power consumption of this work is far more than that of [25]. Although for this work, the throughput is 2x higher and PSNR is lower than [25], high power consumption is sensitive when applying to IoT. Please explain this.
Response: We thank for the reviewer's comment. In this work we want to improve the performance of compression rate and the transfer throughput with the IOT which need the real time image process. The high power consumption is indeed a problem that needs to be reduced. We will focus on this issue in the future. An explanation of this problem has been further supplemented in "Conclusions" on page 15 of the manuscript. Image transmission has become a significant burden because of the increasing volume of data. Compression techniques must be used to achieve faster data transmission while maintaining image quality. This research proposes a low-complexity, high-compression-ratio image compression method and develops a real-time color image compression VLSI design. Color sampling technology is employed in the new BTC algorithm to reduce computing complexity and enhance compression ratio. The experimental findings demonstrate that utilizing machine learning to train several BTC parameters in order to get the best parameter solution yields good results. According to the comparison results, the suggested technique has the best compression performance and the highest throughput. The FOM successfully improved by 33% as a result. In addition, the BTC algorithm now includes a threshold optimization mechanism to prevent image distortion. To lessen the cost of sampling redundant data and to address the difficult issue of enormous data transfer in the Internet of Things. In the future, using cutting-edge technologies can be expected for further improvements. The readout circuit can boost the frame rate of high-speed image sensors or reduce power consumption. Large-scale image sensors will be demonstrated in the future, along with the improvement of effective sampling algorithms and further noise and power consumption reductions.
Q6. Minor: Why not putting Figure 16 in the hardware design section before the experiment?
Response: We thank for the reviewer's comment. Because the Figure 16 is the chip hardware architecture about Table 7 which is tape out the TSMC 0.18um in the result. This figure is show the block diagram of whole hardware architecture which design by verilog and route and placement by CAD tool. Each block in this figure was described each signal transmission. In view of this, we putting figure 16 in section 4 and after Table 7.