structure joint with two pass approach ensure that the matching module updates support window and calculates corresponding cost value in every clock cycle. In order to maximize allowed frequency, some complex operations like Multiple Addition and WTA are divided into a set of pipeline stages. Figure 18 illustrates the scheduling of disparity estimation. Firstly, $35/2 - 1 = 17$ rows rectified image data are needed to initialize scan line buffers. The rectification module generates rectified image data once every four clock cycles as it requires fetching four pixel data to do bilinear interpolation. The initialization signal (INIT) holds low until the end of buffer initialization. When the INIT goes high, it indicates that the following module should initialize its processing state. All the following stages in our design are synchronized with the rectified data generation rate. The components of the stereo matching module are timed by data enable signal (DAE) indicates that there is a new rectified data input. After pipeline latency, the disparity candidates with minimum cost are generated by WTA module and synchronized with DAE signal. In order to do the uniqueness check, the 60 most recent disparity data are collected in the FIFO memory. At the same time, the final disparity values are calculated through the sub-pixel estimation and median filter modules. The output data enable signal (DOE) indicates that there is final disparity data on the DATA bus. The clock frequency for the proposed system is 60 MHz. The highly parallelized pipeline structure enables one disparity data output of every four clock cycles. A pair of 640 x 480 images are processed at 15 Mpixels/s, which is equivalent to 51 frames per second (fps). In the metric of points times disparity per second (PDS), this system achieves a performance of $940 \times 10^6$ PDS, which is suitable for demanding applications. We also compare the proposed system to other stereo vision methods reported. As shown in Table 3, nearly all the stereo vision systems use fixed support region during the correlation. Taking advantage of incremental calculation schemes during aggregation, the systems like can exploit fully the parallelism and achieve very high speed. While the PDS metric reflects the density and the speed of the system, the accuracy of the implemented algorithm is another factor to be considered. Although our method is slower than the state-of-art fixed window methods, an important feature of our system is its high-performance AW algorithm and integration due to our efficient modification.

In order to evaluate the disparity quality of our approach, the Middlebury stereo evaluation is used. This evaluation platform provides a huge number of data sets consisting of the stereo image pair and the appropriate ground truth image. Each image is divided into different regions, namely, non-occlusion regions and discontinuity regions. We measured the percentage of bad pixels on the four images of the dataset (Tsukuba, Venus, Teddy and Cones). Since the system is built for real-time processing of an incoming image, the disparity results for evaluation were generated through