The research paper covers the invention of the chess machine Deep Blue, its system structure and the techniques that were used to become the best of its time chess machine. The main goal was to develop a machine that can successfully compete with the humans chess grandmasters in tournament conditions. Such machines were available since 1980s, but in 1997 IBM Research built Deep Blue, incorporating some of the best ideas of its predecessors.It is the first chess machine to defeat the then-reigning World Chess champion Gary Kasparov.

The main ideas and algorithms that were major part of each machine created so far were the usage of quiescence search, iterative deepening, transposition tables and the NegaScout algorithm. These algorithms combined with the significant hardware power, Deep Blue was able to search up to 300 million positions per second, with average system speed for searches longer than 1 minute of 126 million positions per second. This was possible due to the large searching capacity allowing it to analyze much more positions than the earlier machines and being able to explore position to some reasonable minimum depth. This was done by using massive parallel search that is a hybrid between software and hardware. In this setup, the evaluation function for the search algorithm was implemented in the hardware search giving it a constant execution time.

An important part of Deep Blue is the hardware chess chip, which contains three parts, responsible for the move generation, evaluation function and search control. The move generation part is controlled by a finite state machine and uses a specific move ordering close to best-first search, which allows it to perform more efficient search in game trees. The evaluation function part is composed of two evaluation functions - one for fast evaluation and one for slow, which is a common technique used to generate a good enough approximation instead of an expensive full evaluation. In the search control part, a number of state machines implement a null-window alpha-beta search, which simplifies the hardware design, but in some cases, when searching for an exact score in a given range, it leads to multiple searches.

The software search of Deep Blue introduced a new selective search algorithm called "dual credit with delayed extensions", which is based on the depth-limited version of alpha-beta using the negamax formulation. The main idea is to prevent search explosion by delaying extensions, when searching all possible moves. Instead each move accumulates credits, which may be used for search extensions at some point. The hardware search is performed on the chess chip, where a fixed-depth null-window search is used including a quiescence search. To keep balance between the speed of the search and the efficiency, the searches are only shallow, reaching 4-5 depth. Important limitation of the hardware search is the lack of a transposition table. This requires the upper levels of the search to be performed in the software, where an access to such table is available.

The evaluation function is a sum of more than 8000 features. Some of them are static - they are initialized at the beginning of the search. Others are dynamic - their values are scaled during the search. Important part is the large database of books with opening moves or endgames, that could help the machine pick the best move at different stages of the game.

Although Deep Blue did manage to accomplish its mission, there were a lot of areas left for improvement for its successors, mainly in the search and the evaluation function algorithms.