It is a well known fact that any matrix is unitarily equivalent to a matrix with constant diagonal entries. However, current proofs of this are only existential, and provide no assistance in actually constructing such a matrix. We derive an explicit algorithm of $O(n)$ steps for finding a unitary that performs such a change. We also show that as a function mapping matrices to corresponding unitaries, this algorithm is continuous on an open, dense, subset of $\mathbb{M}_n$. Furthermore, we examine generic points of discontinuity of all such functions, and construct a finite set of functions such that at least one is continuous wherever possible. (Received August 13, 2009)