cost ratio adaptively chosen for classifiers. The experimental results have shown the proposed approach can achieve the superior performance. In the future, the performance of the proposed approach will be further improved, with more effective yet efficient under-sampling and over-sampling methods.

Table 3: *AUC* of 14 methods.

	SVM	Bagg	Ada	Asym	Under	SMOTE	Chan	RF	BRF	Under-RF	Over-RF	Cascade	Easy	My approach
car	0.991	0.995	**0.998**	**0.998**	0.989	0.995	0.996	0.784	0.749	0.786	0.785	0.996	0.994	0.993
ionosphere	0.980	0.962	0.978	0.979	0.973	0.978	0.979	0.981	0.969	0.976	0.981	0.976	0.974	**0.984**
letter	0.999	0.997	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	0.999	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
phoneme	0.910	0.955	**0.965**	**0.965**	0.953	0.964	0.960	**0.965**	0.960	0.952	0.964	0.962	0.958	0.911
satimage	0.936	0.946	0.953	0.953	0.941	0.946	0.955	0.961	0.952	0.953	**0.962**	0.949	0.947	0.947
wdbc	0.995	0.987	0.994	0.994	0.993	0.994	0.993	0.991	0.990	0.991	0.991	0.994	0.993	**0.995**
abalone	0.776	0.824	0.811	0.812	0.830	0.831	0.850	0.827	0.853	0.842	0.823	0.828	0.847	**0.865**
balance	0.618	0.439	0.616	0.619	0.617	0.617	0.652	0.435	0.558	0.593	0.458	0.637	0.633	**0.890**
cmc	0.692	0.705	0.675	0.675	0.671	0.680	0.696	0.669	0.683	0.676	0.660	0.686	0.704	**0.726**
haberman	0.706	0.669	0.641	0.639	0.646	0.647	0.638	0.645	0.677	0.643	0.641	0.653	0.668	**0.706**
housing	0.801	0.825	0.815	0.815	0.805	0.816	0.811	0.828	0.798	0.820	0.826	0.808	0.825	**0.839**
mf-morph	0.917	0.887	0.888	0.888	0.916	0.912	0.912	0.880	0.901	0.91	0.881	0.905	0.918	**0.931**
mf-zernike	0.900	0.855	0.795	0.801	0.881	0.862	0.903	0.840	0.866	0.889	0.854	0.891	0.904	**0.928**
pima	0.828	0.821	0.788	0.788	0.789	0.792	0.786	0.821	0.809	0.818	0.819	0.799	0.809	**0.828**
vehicle	0.852	0.859	0.854	0.853	0.846	0.858	0.856	0.869	0.850	0.855	0.866	0.856	0.859	**0.879**
wpbc	0.728	0.688	0.716	0.721	0.694	0.709	0.706	0.677	0.646	0.661	0.670	0.712	0.707	**0.728**
average	0.851	0.838	0.842	0.843	0.846	0.850	0.855	0.823	0.828	0.835	0.823	0.853	0.858	**0.884**

Table 4: *F-measure* of 14 methods.

	SVM	Bagg	Ada	Asym	Under	SMOTE	Chan	RF	BRF	Under-RF	Over-RF	Cascade	Easy	My approach
car	0.909	0.933	**0.967**	0.966	0.884	0.930	0.916	0.307	0.521	0.513	0.518	0.945	0.917	0.943
ionosphere	0.926	0.883	0.907	0.910	0.900	0.907	0.910	0.906	0.887	0.895	0.904	0.903	0.903	**0.929**
letter	0.961	0.962	0.988	0.987	0.903	0.954	0.905	0.979	0.889	0.895	0.986	0.979	0.909	**0.990**
phoneme	0.726	0.834	0.850	**0.852**	0.819	0.847	0.837	0.850	0.821	0.813	0.851	0.833	0.822	0.730
satimage	0.582	0.641	0.664	0.668	0.546	0.610	0.607	0.666	0.553	0.557	**0.689**	0.647	0.572	0.607
wdbc	0.965	0.938	0.956	0.956	0.952	0.957	0.954	0.954	0.945	0.948	0.955	0.951	0.951	**0.965**
abalone	0.025	0.170	0.210	0.222	0.367	0.379	0.400	0.189	0.382	0.375	0.253	0.378	0.375	**0.432**
balance	0.000	0.000	0.000	0.000	0.175	0.149	0.156	0.000	0.167	0.168	0.000	0.198	0.161	**0.443**
cmc	0.137	0.362	0.388	0.400	0.429	0.421	0.437	0.347	0.441	0.435	0.408	0.437	0.453	**0.473**
haberman	0.204	0.334	0.348	0.360	0.442	0.405	0.380	0.321	0.468	0.445	0.348	0.431	0.463	**0.470**
housing	0.264	0.419	0.475	0.485	0.529	0.532	0.523	0.445	0.515	0.537	0.490	0.516	0.523	**0.558**
mf-morph	0.011	0.263	0.321	0.344	0.579	0.560	0.635	0.261	0.627	0.602	0.349	0.587	0.623	**0.650**
mf-zernike	0.087	0.183	0.188	0.191	0.538	0.538	0.577	0.144	0.500	0.530	0.292	0.538	0.567	**0.603**
pima	0.612	0.644	0.611	0.613	0.644	0.627	0.618	0.641	0.663	0.668	0.656	0.648	0.654	**0.669**
vehicle	0.477	0.526	0.545	0.561	0.623	0.615	0.608	0.544	0.633	0.633	0.564	0.618	0.637	**0.669**
wpbc	0.301	0.410	0.432	0.444	0.449	**0.459**	0.448	0.393	0.401	0.419	0.397	0.450	0.438	0.396
average	0.449	0.531	0.553	0.559	0.611	0.618	0.619	0.496	0.588	0.589	0.541	0.628	0.623	**0.658**

Table 5: *G-mean* of 14 methods.

	SVM	Bagg	Ada	Asym	Under	SMOTE	Chan	RF	BRF	Under-RF	Over-RF	Cascade	Easy	My approach
car	0.944	0.964	0.980	0.981	0.956	0.969	0.970	0.452	0.693	0.687	0.690	0.980	0.973	**0.982**
ionosphere	0.941	0.906	0.928	0.922	0.918	0.923	0.923	0.918	0.911	0.916	0.918	0.920	0.921	**0.941**
letter	0.972	0.972	0.989	0.988	0.994	0.995	0.992	0.980	0.988	0.993	0.987	**0.996**	0.994	0.988
phoneme	0.790	0.880	0.8901	0.892	0.889	**0.899**	0.897	0.892	0.893	0.887	0.897	0.894	0.892	0.826
satimage	0.703	0.729	0.754	0.761	0.671	0.862	0.681	0.744	0.681	0.683	0.782	0.875	0.687	**0.890**
wdbc	0.972	0.950	0.963	0.963	0.963	0.964	0.962	0.962	0.957	0.960	0.963	0.962	0.963	**0.972**
abalone	0.676	0.637	0.696	0.712	0.765	0.742	0.778	0.765	0.790	0.778	0.557	0.752	0.780	**0.792**
balance	0.000	0.000	0.001	0.002	0.560	0.563	0.563	0.000	0.548	0.548	0.000	0.616	0.580	**0.607**
cmc	0.268	0.509	0.561	0.577	0.623	0.605	0.623	0.510	0.634	0.627	0.587	0.631	0.647	**0.666**
haberman	0.307	0.476	0.502	0.515	0.592	0.562	0.536	0.476	**0.618**	0.593	0.504	0.585	0.611	0.587
housing	0.582	0.753	0.615	0.627	0.725	0.710	0.698	0.580	0.718	0.735	0.638	0.710	0.730	**0.738**
mf-morph	0.018	0.483	0.660	0.694	0.875	0.841	0.920	0.379	0.918	0.888	0.897	0.863	0.915	**0.926**
mf-zernike	0.185	0.378	0.486	0.492	0.848	0.815	0.854	0.320	0.831	0.844	0.819	0.817	0.870	**0.874**
pima	0.696	0.720	0.694	0.696	0.719	0.708	0.706	0.717	0.735	**0.740**	0.731	0.728	0.732	0.730
vehicle	0.688	0.642	0.664	0.679	0.768	0.743	0.738	0.659	0.780	0.779	0.689	0.757	0.780	**0.805**
wpbc	0.578	0.610	0.637	0.649	0.617	0.610	0.585	0.477	0.567	0.588	0.594	**0.630**	0.628	0.598
average	0.513	0.625	0.644	0.659	0.792	0.775	0.782	0.596	0.778	0.777	0.653	0.794	0.806	**0.820**