Faint submillimeter sources detected with the Submillimeter Common-User Bolometer Array on the James Clerk Maxwell Telescope have faced an identification problem due to the telescope’s broad beam profile. Here we propose a new method to identify such submillimeter sources with a mid-infrared image having a finer point spread function. The Infrared Space Observatory has provided a very deep 6.7 μm image of the Hawaii Deep Field SSA13. All three faint 850 μm sources in this field have their 6.7 μm counterparts. They have been identified with interacting galaxy pairs in optical images. These pairs are also detected in the radio. Two of them are optically faint and very red ($I > 24$, $I - K > 4$), one of which has a hard X-ray detection with the Chandra satellite. As these observing properties are similar to those of local ultraluminous infrared galaxies, their photometric redshifts are derived based on submillimeter to mid-infrared flux ratios assuming a spectral energy distribution (SED) of Arp220. Other photometric redshifts are obtained via $\chi^2$ minimization between the available photometry data and template SEDs. Both estimates are in the range $z = 1–2$, in good agreement with a spectroscopic redshift and a millimetric one. The reconstructed Arp220 SEDs with these redshift estimates are consistent with all the photometry data except Chandra’s hard X-ray detection. The sources would be a few times more luminous than Arp220. With an assumption that AGN contributions are negligible, it appears that extremely high star formation rates are occurring in galaxies at high redshifts with massive stellar contents already in place.