



Open Source IoT monitoring system of shallow geothermal energy integrated with OpenGeoSys

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Shallow geothermal energy is widely used to convert fluctuating energy sources into the stable form of energy stored in the ground. Either individual or community can utilize boreholes to meet the demand for heating or cooling in need. Balancing heating in winter and cooling in summer helps stabilize the energy source in the name of sustainability in an extended period. Monitoring technology is of paramount importance in achieving the balanced utilization of the geothermal energy. Due to high cost, the energy system has been central and massive. With the dramatic change in hardware, software, and open source community, we could decentralize small to sizeable geothermal energy monitoring system. The decentralization of energy monitoring in the study is composed of 1. cheap hardware for sensors and electrical boards, 2. cheap internet infrastructure, and 3. open source community support. We used Raspberry Pi, Arduino, and the cheap sensors and flowmeters for hardware, Linux, Apache, MySQL, Python, C and C++, bash, Google charts, TCP/IP, OpenVPN and so on for software, and technical help from GIT, Stack Overflow, StackExchange, Google, Youtube, various WordPress blogs and forums for open source community support. Finally, we conducted simulation for calibration and prediction of the borehole thermal energy storage (BTES) in 2D and 3D using OpenGeoSys, a scientific THMC model with various open source tools and software.

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