

HEATING HOMES WITH ROBOTS

Suspended flooring helps construction workers build level floors above uneven and damp surfaces. However, this has created its own problem: the space between the floor and ground allows cold air to enter properties and can result in 10% to 25% of total heat loss. To solve this problem, construction technology company Q-Bot has created a series of robots that can install underfloor insulation without messy construction work.

The need for a more convenient way to install underfloor insulation arose in a conversation between architect Tom Lipinski and Peter Childs, a professor in engineering design. Along with Q-Bot CEO Mathew Holloway, they addressed the challenge of insulating older housing with the development of a fleet of mini robots that use the Q-Bot team's expertise in architecture, heat transfer, robotics, data management, and business and technology management throughout the whole installation process. In 2014, the first trial of the robots demonstrated an 80% reduction in heat loss through the floor and a saving on fuel bills for residents of up to £300 a year.

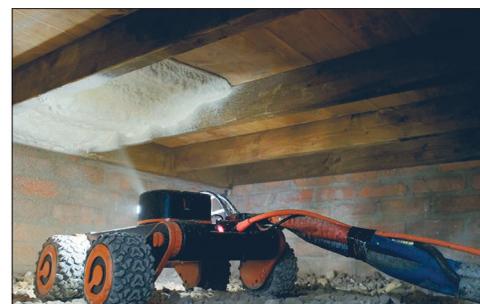
Insulating homes with suspended wooden floors often involves removing furniture, carpets and floorboards, then cutting and fitting insulation between floor joists before refitting the floorboards and carpets, which can be an expensive, time-consuming and messy process. A Q-Bot robot can fit insulation in one to two days, creating little or no waste.

Q-Bot allows insulation to be installed in houses without ripping up the floorboards. Its technology includes a survey robot that can be inserted into the underfloor cavity to inspect the area and produce a computer-aided-design model from the sensor array the robot carries. SurveyBot can enter

inaccessible and hazardous areas such as crawl spaces, cable trenches and sewers. The robot creates accurate 3D textured maps with visual and thermal information, and can see in the dark. After SurveyBot has produced the model, the property can be assessed and a decision taken on whether to book a treatment.

If installation goes ahead, the company then deploys its Spraybot in the underfloor space. Spraybot consists of a sensor array, a spray turret that carries an automated spray-nozzle, chassis, drivetrain and supply tube, and can apply thermally insulating material to the underside of the suspended flooring. It uses powerful motors and independent suspension to climb over the kind of obstacles that might be found underneath suspended floors and enables the robot to pull the umbilical that supplies the materials for the spray.

The company experimented with different levels of autonomy for the robots, but eventually found that a blended approach was best suited to the application. The technology combines tele-operation, using camera vision, and human inspection with autonomous sensing, motion and material spraying. With support from the Royal Academy of Engineering's Enterprise Hub, the EU's Horizon 2020 programme and Innovate UK, the company has been able to scale up its high-tech construction,



A Mark 6.3 Q-Bot robot in action



Q-Bot Spraybot robots

robotics and retrofit business. The technology is completely manufactured in the UK, and each robot produced increases employment for each of the robot operating teams.

The company is working with housing associations and local authorities to install underfloor insulation in their properties across the UK as part of a drive to address fuel poverty. Each home that is insulated sees a 14% reduction in energy usage for heating, and a reduction of CO₂ emissions of 14,000 kilograms CO₂e over the 42-year nominal lifespan of the insulation.