Robotic Revolution in the Construction Industry: An Autonomous Roof Shingling Robot

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Boosted by an increase in single-family housing, and the rising need for storm-resistant products, the demand for roofing in the U.S. is expected to grow at a compound annual growth rate (CAGR) of 4.9% to reach $19.9 billion in 2021. Simultaneously, the US roofing industry is facing a shortage of skilled employees due to two main factors; older roofers leaving the business and a lack of younger people interested in working in the skilled trades. Along with this increase in roofing, demand comes an increase in injuries related to roofing. Within the construction industry overall, falls from roofs account for one-third of all fall-related fatalities. Nearly 40% of all fatalities in the construction industry for 2014 were from falls. For these reasons I designed and built an autonomous roof shingling robot that could shingle a 4/12 pitch roof using standard shingles. Using the iterative design process, I created a total of 10 prototypes. The final prototype can auto-navigate to a start position, lay shingles and nail the shingles in place continuing this process until the roof is completely shingled. The robot navigates with accurate edge detection while maintaining a parallel position to the front edge of the roof. The robot is built on an open-source microcontroller and uses numerous types of sensors. The robot has four main systems; navigation, locomotion, robotic arm, and nailing system. Each system was tested both independently and completely assembled using custom made machines to verify the specifications for the overall robot.

Awards Won:

Second Award of $1,500