A Fully Functional Closed- Loop System Using Ultrasound Imaging to Automatically Detect Lipohypertrophy in People with Insulin-Dependent Diabetes

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Insulin Dependent Diabetes is a chronic condition that affects over 200 million people worldwide. Diabetic patients keep this disease under control by externally administrating Insulin hormone through multiple daily injections (MDI) or through insulin pumps. One of the key challenges of MDI is the buildup of adipose tissue under the skin, known as Lipohypertrophy. This causes blunted insulin absorption in the subcutaneous fat layer, leading to poor management of diabetes. Lipohypertrophy goes largely undetected since it is not visible to naked eye and hard to detect until the condition gets really severe and painful. Many diabetics have no idea of these fat regions and continue to administer MDI into these low insulin absorption areas leading to further aggravation of the condition. The purpose of this project is to create a fully functional closed loop system that is able to determine Lipohypertrophic regions using ultrasound technology. Utilizing optimized edge detection algorithms the system can detect the existence of fat-buildup and pinpoint the locations affected by Lipohypertrophy. The closed-loop system was tested in three phases; The initial phase tested the algorithm on published Lipohypertrophic Images obtained from the Profil Institute for Metabolic Research in Germany. The algorithm was able to detect these regions with more than 85% accuracy. The next phases, involved human patients, tested the applicability of this algorithm in real life scenarios. The system was able to properly detect Lipohypertrophy. In conclusion, the fully functional closed loop system uses advanced imaging techniques to automatically detect Lipohypertrophy allowing for determination of optimal injection locations and therby reducing diabetic-related complications.

Awards Won:

Acoustical Society of America: Honorable Mention