An automated insulin delivery pump using a fuzzy logic controller

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Having to regulate blood sugar level as in the case of Diabetes Mellitus is a common medical problem. Delivery of Insulin treatment manually to control blood sugar, poses many problems such as risk of hypoglycemia, need of tedious monitoring and expert's opinions. As a solution automated Insulin delivery pump, which automatically adjusts the insulin delivery rate according to the fluctuations of blood sugar level have been proposed. We have developed embedded software for such a pump using a Fuzzy Logic controller.

Current blood sugar level would be the main input to this device, and this input has been fuzzified using a triangular membership function in to three sets, Low, Normal and High. The output of the fuzzy logic controller is the adjusted insulin delivery rate according to the current blood sugar level. Similar to the input, output has also been fuzzified using a triangular membership functions into three sets, Low, Medium and High. A fuzzy inference engine has been developed, which associates input and outputs with following fuzzy rules.

- If the blood sugar is Low, then the rate of insulin delivery has to be Low.
- If the blood sugar is Normal, then the rate of insulin delivery is kept Medium.
- If the blood sugar is High, then the rate of insulin delivery should be High.

Given the input, using these rules it gives the output in terms of a fuzzy set, which is defuzzified to derive the crisp value that is the adjusted insulin delivery rate. Defuzzification is achieved using the *Center of Gravity* or the *Centroid method*, where the defuzzified value is defined as the value, which divides the area under the graph membership function into two equal subareas.

This device gives solutions to lack of availability of experts as it embeds the knowledge of the experts in the fuzzy rule base and expert reasoning is achieved using the inference engine. Also it reduces the manpower and the cost as it eliminates the tedious manual monitoring of the blood sugar level. Further, this work gives insight to develop many other medical appliances such as various infusion pumps, ventilators, etc., using the same technique.

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