IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

BLOOD GLUCOSE CONTROL USING FOPID CONTROLLER BASED ON NEURO FUZZY SYSTEM

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ABSTRACT

The amount of sugar found in the blood is known as blood glucose. The main source of glucose is food. The blood cells carry the glucose throughout the body for energy. If the level of glucose goes higher than the normal level it tends to diabetes disease occurs in our body. The normal blood glucose level is 70-110mg/dl. Type 2 diabetes is a chronic condition in which your body becomes resistant to insulin or doesn't produce enough insulin to regulate blood sugar levels properly. Insulin is a hormone produced by the pancreas that helps transport glucose from the bloodstream into your cells to be used for energy. When you have type 2 diabetes, your cells become resistant to insulin, which causes sugar to build up in your bloodstream and can lead to a variety of health problems. Regulating the blood glucose level in the body within the limit is a difficult task. To overcome these issues, In this project, we proposed a Neuro-Fuzzy Logic Algorithm used to regulate the system model. Finally, this result is compared with existing conventional PID, FOPID, and Fuzzy PID controllers which use the PSO algorithm. There are several risk factors for developing type 2 diabetes, including being overweight or obese, having a sedentary lifestyle, having a family history of diabetes, and being over the age of 45. Symptoms of type 2 diabetes can include increased thirst, frequent urination, blurred vision, fatigue, and slow healing of wounds.

Keywords: Diabetes, Glucose, FOPID Controller, Neuro-fuzzy.

1.INTRODUCTION

The artificial pancreas (AP) system or closed-loop blood glucose (BG) regulation is a technological advancement that aims to relieve diabetic subjects from their current decision-making burden while tightening their BG levels. However, large disturbances such as meals and exercise still pose great challenges to a fully closed-loop system.BG regulation with unannounced physical activity for type II diabetic subjects is addressed. We use a coordinated control strategy with insulin infusion and extra carbohydrates (CHO) for hypoglycemia avoidance. The insulin algorithm is based on a proportional–derivative controller with insulin feedback and the so-called safety auxiliary feedback element (SAFE) layer, and the algorithm for CHO is based on a predictive, quantified proportional-derivative controller.

Diabetes is a sickness that affects a large number of individuals from one side of the planet to the other. In a bid to work on diabetics' personal satisfaction, much work is going into the improvement of the artificial pancreas and different techniques to convey insulin in a computerized strategy that doesn't expect patients to convey insulin on them nor stress over the organization of measurements. FOPID control-based Neuro-Fuzzy enhancement procedure is a decent technique to register the insulin mixture to direct blood glucose. Much

examination has likewise been finished on finding models that recreate the human glucose-insulin connection. Be that as it may, for execution in an implanted framework, the model can't be excessively muddled, yet needs to precisely recreate the human framework. The negligible model proposed has just five differential conditions and the model was then linearized.

2. OBJECTIVE

To determine the blood glucose concentrations following an oral glucose load.

To be able to discuss the physiological mechanisms by which blood glucose concentrations are controlled.

To recognize the importance of Glucose Tolerance Tests (GTTs) in diagnosis, particularly of diabetes mellitus.

To know the blood glucose level before and after meal.

3.LITERATURE SURVEY

BLOOD-GLUCOSE REGULATION USING FRACTIONAL-ORDER PID CONTROL- MOHALLEM PAIVA-2019

This paper proposes another methodology utilizing a Fractional Order Proportional Integral Derivative (FOPID) Controller. To the best of the creators' information, this control system has never been applied to this issue. The regulator is utilized to characterize how much insulin to be infused to the patient, as per the blood glucose fixation levels. The primary intention is to keep the blood glucose between laid out limits, keeping away from both hypo-and hyperglycemia. The FOPID results are contrasted and the one gotten with a standard PID regulator et al. furthermore, with those of a MPC approach The FOPID is better than the old style PID regulator because of the quantity of change boundaries-not just the three boundaries connected with the PID activity, yet in addition two more showing the derivater and integrator orders, which are not really number. The FOPID approach is normal to introduce greater adaptability and better versatility to the plant dynamical properties. Besides, our past investigations have shown that fractional Order system of low request are able to address.

DESIGN MODIFIED SECOND ORDER SLIDING MODE CONTROLLER BASED ON ST ALGORITHM FOR BLOOD GLUCOSE REGULATION SYSTEMS -EKHLAS H. KARAM*, EMAN H. JADOO-2020

Diabetes is separated into two significant sorts. The type1 diabetes Mellitus (T1DM) and Type 2 diabetes mellitus (T2DM) in the principal type the patient's body can't deliver sufficient insulin and portions of insulin should be infused into the human body to control blood glucose levels, while the subsequent kind beginnings with insulin obstruction, a condition in which cells don't answer as expected to insulin. This sort of diabetes is a typical kind and known as noninsulin-subordinate diabetes. In order to prevent the effects of high blood glucose levels the best approach is to administer insulin during a moment when blood glucose is supposed to rise. With the Advance of technology, the so-called artificial pancreas emerged its consists of three main components, glucose sensor, insulin pump and control techniques to generate the necessary insulin dose based on glucose measurements. The close-loop system has been stimulated for various patients with various boundaries, within the sight of the food consumption unsettling influence also, it has been shown that the glucose level is balanced out at its basal worth (reference contribution to) a sensible measure of time. The adequacy of the proposed regulator contrasted and the traditional SOSMC are checked by recreation results for three patients.

OPTIMIZATION OF PIDD2-FLC FOR BLOOD GLUCOSE LEVEL USING PARTICLE SWARM OPTIMIZATION WITH LINEARLY DECREASING WEIGHT -MOHAMMAD A. JARADAT ,-2020

The diabetes mellitus alludes to faulty guideline of blood glucose level (BGL), it tends to be related with low production or inefficient use of insulin. In Jordan, a concentrate in 2004 showed that the diabetes influences around 15% of the grown-ups. Brown et al. led a projection concentrate on the populace in Jordan with four qualities for pervasiveness. The review showed that the normal diabetic grown-up's populace from 0.76 to 3.04 million by 2050. Simulation results show that the proposed method acts robustly and can

overcome uncertainties and external disturbances. The blood glucose level remains in safe region In all case. So the proposed method can be used in an artificial pancreas.

MODEL FREE SLIDING MODE CONTROLLER FOR BLOOD GLUCOSE CONTROL: TOWARDS ARTIFICIAL PANCREAS WITHOUT NEED TO MATHEMATICAL MODEL OF THE SYSTEM-AUTHOR :NAHIDEBRAHIMI-2020

In this paper, a model free third request terminal sliding mode regulator is created and applied to blood glucose regulation system. So in this paper, an information driven control strategy is proposed which needn't bother with a pre determined numerical model of the framework. The proposed technique utilizes a third request terminal sliding mode regulator to conquer the issue in limited time without gabbing. It likewise utilizes an unsettling influence assessment procedure to dismiss outside aggravations. The sliding mode calculation is outfitted with a relapse calculation to deliver its need to display of the framework. It is demonstrated hypothetically that the technique is steady and the blunder merges to nothing. To decide the boundaries required in this strategy, a calculation is given. Simulation results show that the proposed method acts robustly and can overcome uncertainties and external disturbances. The blood glucose level remains in safe region In all case. So the proposed method can be used in an artificial pancreas.

VARIABLE STRUCTURE ROBUST CONTROLLER DESIGN FOR BLOOD GLUCOSE CONTROL REGULATION FOR TYPE 1DIABTIC PATIENT:A BACKSTEPPING APPROACH , MOHAMADREZA HOMAYOUNZADE -2021

This strategy for controlling diabetes is some way or another open circle. Since in an open loop controlled framework, the regulator doesn't have a clue about the degree of insulin in the blood whenever, thus any unsettling influence that happens during imbuements, for example, the meal admission and the pace of enactment, may make the framework temperamental. Therefore, this strategy is certainly not an exact approach to settle the blood glucose level because of its failure to accomplish the ideal BGC. In the criticism control technique, not at all like open-loop one, the regulator estimates the blood insulin level at every moment, and the control order is planned appropriately as an element of the deviation of the blood glucose-insulin level from its ideal size. It is notable that one of the benefits of an input controlled framework is its natural strength against outside unsettling influence and vulnerabilities. Thusly, an input control strategy for controlling the degree of blood glucose by on the web input from persistent glucose checking (CGM) is of the prime interests. The arising arrangement is a robotized closed- circle insulin conveyance framework named a counterfeit pancreas (AP). This study proposed another variable construction vigorous blood- glucose guideline approach for a dubious Bergman's negligible model utilizing a backstepping approach. The dependability of the framework was demonstrated using the Lyapunov hypothesis.

4.SYSTEM ANALYSIS

4.1 EXISTING SYSTEM

In existing framework, PID is used. PID is (relative vital subsidiary) regulator is a strong control system, that limits the distinction between a set worth furthermore, process factors. Vigor, effortlessness and extensive variety of appropriateness are the fundamental reasons of PID regulators wide use . Tuning system and deciding the ideal relative, essential and subsidiary boundaries is a basic issue in PID regulators . To defeat these troubles programmed tuning of PID regulators has been completely concentrated by specialists [3] In expansion, to further develop PID regulator's consistent state and transient execution partial request PID regulators were presented and executed. A good control strategy requires an immense measure of information and experience. To dodge this issue, studies have been done to plan partial PID regulators unnecessary of a specialist's experience and information, by use of hereditary calculation . Investigates have been embraced to control blood glucose fixation in type 1 diabetics by the means of PID regulators and it was shown to be proficient however not absolutely successful, because of its unfortunate over shoot and settling time which could bring about a few radical consequences for diabetics subjects [7].In Type 1 diabetes mellitus (T1DM), the beta cells that produce insulin are annihilated by the safe framework. This type is most normal in kids and young people. On the other hand, over 90% of diabetic patients have Type 2 DM (T2DM). In T2DM, the insulin created by the pancreas doesn't work as expected because of protection from the insulin. Particularly for patients with T1DM, exogenous insulin ought to be imbued at a fitting rate to keep blood glucose fixation (BGC) in a normoglycemic range (70-180 mg/dL [1]). To inject exogenous insulin at a suitable rate, a shut

circle control framework has been generally utilized [4], as delineated in Figure 1. The shut circle control framework is moreover known as the counterfeit pancreas, which comprises of a glucose sensor or ceaseless glucose screen (CGM), a regulator, and an insulin siphon. The CGM signals are sent to the regulator. The regulator then, at that point, utilizes a control calculation to send the information of the legitimate insulin portion to the insulin siphon. As of late, concentrates on demonstrating the glucose-insulin administrative arrangement of the patient with T1DM have expanded. These models have extraordinary significance with regards to figuring out the framework. A few of these models, for example, Bergman's insignificant model, the Hovorka model, and UVa/Padova's model, are extremely normal [5]. Because of advances in demonstrating, control hypothesis, and biomedical designing, a few control calculations have been proposed to keep the BGC of the patients with T1DM in the normoglycemic range. These calculations are mostly founded on old style regulators [6], versatile regulators, or powerful regulators . Despite the fact that these regulators have a decent exhibition in recreation studies, they can't adapt to the vulnerability what's more, nonlinearity of natural frameworks, for example, that of the glucose-insulin administrative framework [2].

EXISTING BLOCK DIAGRAM

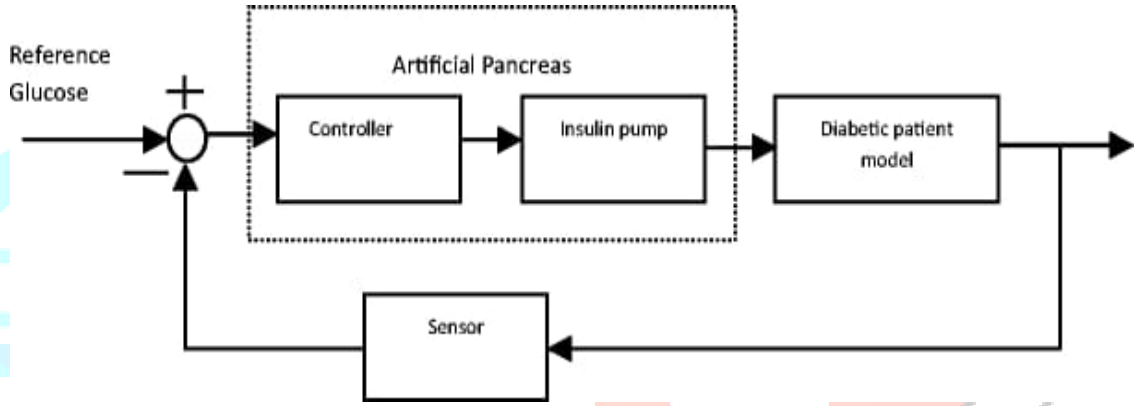

FIG 1: EXISTING BLOCK DIAGRAM

4.2 METHODOLOGY

Fluffy rationale (FL) is a promising way to deal with taking care of such complex control issues. FL permits the catch of significant data about the way of behaving of the controlled variable, which can be a decent aide that understands the fake pancreas. FL is unfeeling toward the changeability of framework boundaries and can survive between and intra patient changeability . In , fluffy rationale regulators (FLCs) showed somewhat fruitful brings about keeping the BGC of the patients with T1DM in a normoglycemic range. In any case, they have certain inconveniences . Most rely upon Bergman's negligible model, which might bring about less effective treatment, in light of the fact that the oscillatory nature of the glucose-insulin framework isn't precisely introduced by the negligible model. The fundamental motivation behind these regulators is to keep BGC at a foreordained reference esteem. Thusly, the oscillatory nature of the glucose-insulin elements in solid people isn't imitated. In , the fluffy guidelines and fluffy enrollment capabilities (MFs) of the regulators depend on master information. Consequently, it is very challenging to gain ideal influence through tuning the MFs with an experimentation technique. Taking into account these weaknesses, an advanced fluffy PID regulator in light of the nonlinear defer differential model of glucose-insulin is intended for managing the BGC of patients with T1DM. The nonlinear postponement differential model (for example the reference model) shows the glucose status in sound people with planned insulin mixture. The motivation behind the improved regulator is to mirror the glucose swaying of the reference model. To accomplish this, counterfeit honey bee state (ABC) enhancement calculation is utilized to choose the ideal boundary upsides of the MFs of every fluffy variable and the weighting factors.

4.3 PROPOSED SYSTEM

In the adopted control strategy, the control variable is the insulin infusion and the system output is the plasma glucose concentration which is measured by a sensor with a delay of 10 min. As is customary, the error signal is defined by the difference between the output and a specified target value.

PROPOSED BLOCK DIAGRAM

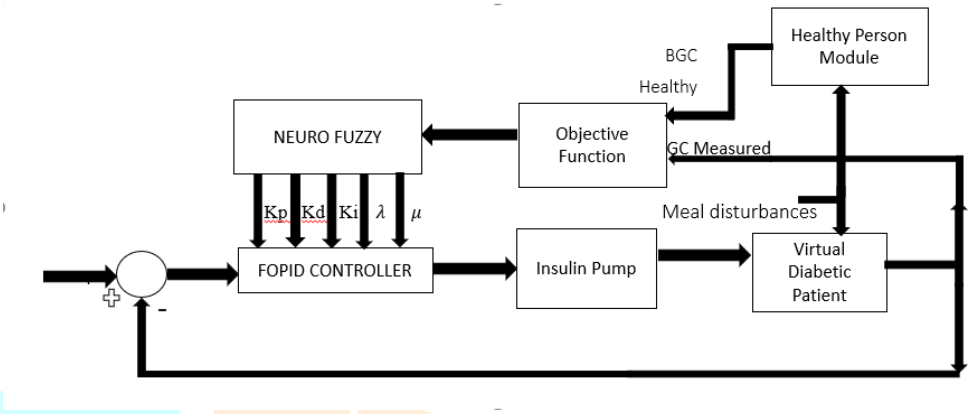

FIG 2: PROPOSED BLOCK DIAGRAM

The distinctive element of the PID regulator is the capacity to utilize the three control terms of relative, FOUND indispensable and subordinate effect on the regulator result to apply\exact and ideal control. Term P is relative to the ongoing worth of the SP − PV mistake. For instance, in the event that the blunder is enormous and positive, the control result will be proportionately huge and positive, considering the addition factor "K". Utilizing corresponding control alone will bring about a blunder between the set point and the genuine cycle esteem since it requires a mistake to produce the relative reaction. Assuming that there is no mistake, there is no restorative reaction. Term I represents past upsides of the SP − PV mistake and coordinates them over the long haul to deliver the I expression. For instance, in the event that there is a leftover SP − PV mistake after the utilization of relative control, the basic term tries to kill the remaining blunder by adding a control impact because of the noteworthy combined worth of the blunder. At the point when the blunder is killed, the fundamental term will stop developing. This will bring about the corresponding impact lessening as the mistake diminishes, yet this is made up for by the developing fundamental impact. Term D is a best gauge representing the things to come pattern of the SP − PV blunder, in light of its ongoing pace of progress. It is at times called "expectant control", as it is successfully looking to diminish the impact of the SP − PV mistake by applying a control impact created by the pace of blunder change. The more fast the change, the more prominent the controlling or damping impact. The parameters like λ,μ are used as tuning parameters in this controller. It has enhance the output / result in a accurate manner.

5. CONCLUSION

Along these lines, we have effectively PID control for blood glucose levels for diabetic patients. Thus PID regulators utilize different productive calculations. The model of blood glucose level gave truly horrible worth. Hence, the PID regulator with a quick reaction gives an ideal control of the glucose guideline, as a result of the vital activity can wipe out the consistent state mistake and besides can diminish the ascent season of the regulator move capability while simultaneously the subordinate boundary an eliminate any overshoot and abbreviate the settling season of the regulator move capability. The Ant System initially proposed to take care of a combinatorial streamlining issue. The Ant System strategy performed well and can be worked on additional by reasonable decision of given three information boundaries and weightage networks of the expense capability. As the Ant System technique for enhancement is stochastic in nature, it is plausible to stretch out its application to non-direct and acquire the benefits of more exact glucose-insulin infusion values in people.

6. REFERENCE

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