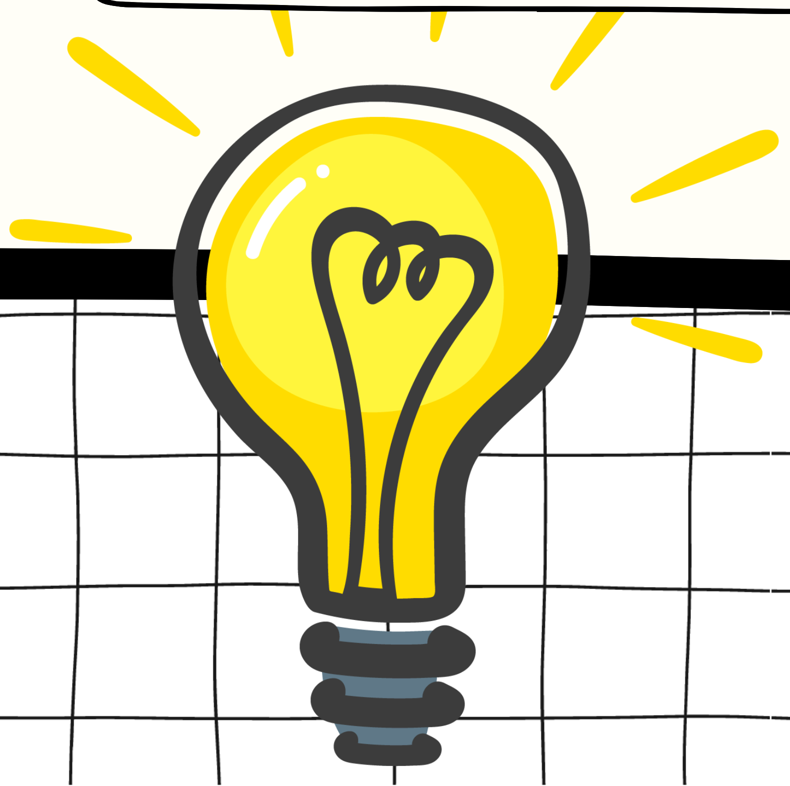
Modern Injector

Stimulating innovation through ideas



Introduction

A modern injector is a precision device intended to deliver controlled amounts of substances, such as fuel, medication, or chemicals, into a target system. The evolution of injectors has been marked by advancements in technology, materials, and design, contributing to improved efficiency and performance. Injectors are essential to many industries, including automotive, medical, and manufacturing.

Idea

SUIT Modern Injector CAD:
cutting-edge injector design leverages state-of-the-art Computer-Aided Design (CAD) technology. Precision-engineered for optimal performance, the SUIT Modern Injector ensures accuracy and efficiency in medical procedures. From intricate details to user-friendly features, our CAD innovation reflects our commitment to advancing healthcare. Join us in revolutionizing medical equipment with a focus on precision, reliability, and the seamless integration of technology.

Process

Working Principle:

The CAD model of a modern injector in Ultimaker Cura reflects the working principle of the actual injector, emphasizing precision and controlled substance delivery. The working principle in the CAD model involves:

a. Detailed Component Modeling:
- Creation of a 3D model that accurately represents the injector body, nozzle, seals, and electronic components.

b. Integration of Functionalities:
Ensuring that the electronic components are seamlessly integrated into the CAD model, reflecting the actual control mechanisms.

c. Simulating Substance Flow:
Visualization of the substance flow path within the injector, emphasizing the controlled injection and spray pattern.

d. Prototyping for Real-World Application:
Utilizing Ultimaker Cura to generate a 3D-printable prototype, enabling a tangible representation of the CAD model.

Materials Required

Insulin Reservoir: A chamber for storing insulin

Pressure Mechanism: A mechanism to create the necessary pressure for insulin delivery.

Nozzle: A nozzle or orifice for expelling the insulin.
Control Electronics: Electronics for controlling the device, including dosage settings and safety features.

Power Source: Batteries or another power source for the electronics and pressure mechanism.

User Interface: Buttons, a display, or other controls for the user to set insulin dosage and initiate injections.

Safety Features: Mechanisms to prevent accidental injections and protect against overuse

Design and Fabrication Steps:

DESIGN THE MECHANICAL COMPONENTS:

Develop the internal structure of the injector, including the insulin reservoir, pressure mechanism, and nozzle.

Consider the size and shape of the device, making it ergonomic and easy to handle.

Pressure Mechanism: Choose a suitable pressure mechanism, which can be a spring, pneumatic system, or other methods.

Ensure the mechanism is precise, consistent, and controllable.

Incorporate a microcontroller to control the injection process and a display for user feedback

User Interface: Implement user-friendly controls for setting insulin dosage.
Include safety measures, such as a confirmation button, to prevent accidental injections.

Safety Features: Integrate safety mechanisms to prevent unintended injections, like a locking mechanism or pressure release valve.

Implement features that restrict the maximum dose to prevent overdose.

Testing and Calibration: Rigorously test the device to ensure it delivers accurate insulin doses.
Calibrate the pressure mechanism and electronics to match the desired dosage settings.

Manufacturing and Assembly: Fabricate the device components, such as the body, reservoir, and nozzle.
Assemble the injector, ensuring all components fit together securely.

Compliance and Regulations: Ensure your device complies with medical device regulations and standards for safety and efficacy.

User Training and Support: Provide user manuals and training materials to ensure safe and proper device usage.

User Research

To design a drug delivery system that will truly resonate with patients, one must first understand the behaviors and motivations of the intended user groups. This requires insight into the unique experiences of those users by conducting research that will drive innovation in the design and development process to create a solution that works in a variety of situations.

Drug manufacturers agree that end-user research and human factors testing are critical when considering the design of a new drug delivery system, such as self-injection devices for diabetes patients. Historically, many companies have relied on patient focus groups to obtain information about user considerations for drug administration systems. However, focus groups don’t always offer the full picture on how patients use drug delivery devices at home, work, and other settings. Initiated partially by evolving regulatory requirements, pharmaceutical manufacturers have begun taking a more personalized approach to understanding end-user needs in various environments and ultimately developing products that can better help patients adhere to treatment regimens.

DESIGNING FOR THE HUMAN CONDITION

Human factors engineering and usability testing seeks to gain a thorough understanding of the potential users' behaviors, motivations, and needs. Three main components for device testing will help optimize how people interact with technology: 1) device users, 2) device use environments, and 3) device user interfaces. Using in-depth statistical analysis, data aggregation and synthesis techniques should yield actionable opportunities for innovations and enhancements that will help make the delivery systems easy to use throughout the treatment regimen

Methods include:

Qualitative: interviews, ethnographic observation, contextual inquiry, and concept evaluation

Quantitative: questionnaires, in-person surveys, and user-based performance testing

Analysis & Synthesis Outputs: affinity diagramming, product adoption road maps, and habits and ideal scenarios

Human Factors/Ergonomics: human error and risk analysis, usability testing, and heuristic analysis .

Usability testing offers a more robust framework that can be broken down into four major components.
They are:
Physical Abilities: anthropometry (the measure of bodies, such as heights or the size of hands), biomechanics (what can be accomplished physically), and sensory abilities (vision, hearing, tactile sense)

Cognitive Abilities: how people process information, the capabilities of memory, the manner in which humans learn new things, and how habits are developed

State of Being: the general health of the expected user, disease states and co-morbidities, mental and emotional states, and motivation for learning new things

Experiences: educational background, knowledge of a particular disease state, and lifelong experiences with objects that will guide behavioral interactions with any delivery system

Patient needs also must be defined appropriately. Three types of needs are important to the success of any development program. Different techniques can be used to elicit and discover these needs, which include:
Expected Needs: Needs that are meaningful to patients; direct observation inside the user's environment is an effective way to document these types of needs

Expressed Needs: Needs that are simple for users to articulate; "think-alouds" and other narrative techniques are best to determine expressed needs

Exciting Needs: This type of "need" typically delights patients because they often do not think about the possibilities as technically possible. Reaction to emotive stimuli, scenarios and storytelling are ways to elicit emotionally based needs

VALUE PROPOSITION

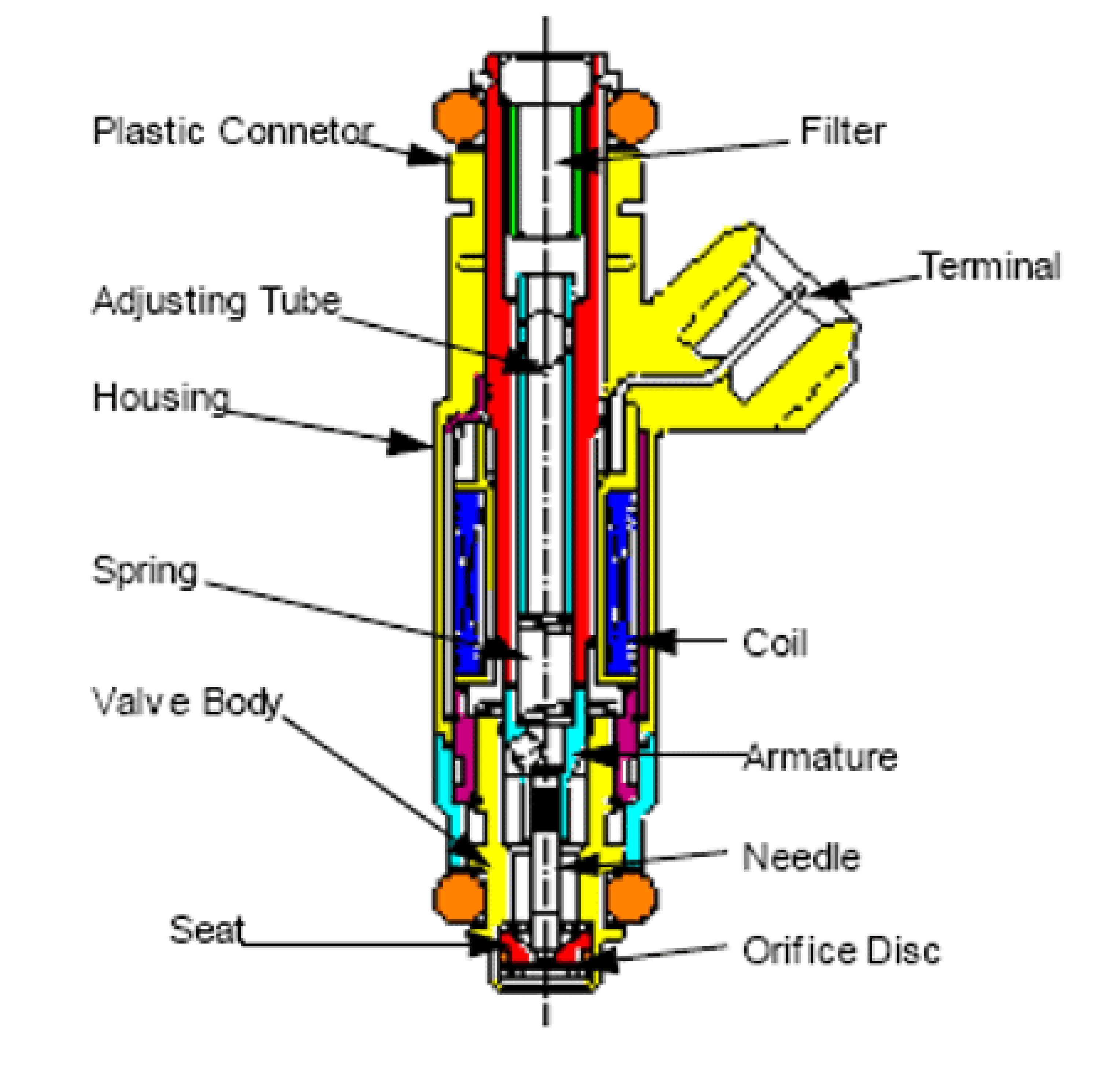
Design Parameter:

1. Fluid feed rate and operating pressure range are the key parameters of an injector, and vacuum pressure and evacuation rate are the key parameters for an ejector.

2.The compression ratio of the injector, P2/P1 is defined as ratio of the injector's outlet pressure P2 to the inlet pressure of the suction fluid P1.

3.The entrainment ratio of the injector, Ws/Wm is defined as the amount Ws (in kg/h) of suction fluid that can be entrained and compressed by a given amount Wm (in kg/h) of motive fluid.

TECHNICAL DESIGN



FINAL PRODUCT

Suit Modern injector CAD :(using Ultimaker Cura):

INTERVIEW -PROBLEMS NOTICED IN TRADITIONAL INJECTORS

Problems need a solution

Old-style insulin injectors, typically refer to traditional syringes and vials.

Pain and Discomfort: Injecting insulin with a traditional syringe can be painful, especially for individuals with a fear of needles or those who need frequent injections. This discomfort can lead to poor adherence to insulin therapy.

Lack of Precision: Traditional syringes may not offer the same level of dosage precision as more modern insulin delivery devices. Inaccurate dosing can lead to either overdosing or underdosing, but of which can have adverse health effects.

Difficulty for Some Patients: Drawing the correct amount of insulin and administering it can be challenging for individuals with limited dexterity, vision impairment, or cognitive difficulties, such as the elderly.

Infection Risk: Reusing syringes without proper cleaning and sterilization can lead to infection risk. This is particularly problematic in areas with limited access to clean water and sanitation.

Waste Generation: The disposal of used syringes can be an environmental concern due to the generation of medical waste, which needs proper disposal.

High Cost: typically high cost of insulin pens and needle-free injectors makes them unavailable for needy peoples

To address these problems, modern insulin delivery systems have been developed , suit modern needle-free injectors. These alternatives offer greater convenience, improved precision, and reduced pain, enhancing the overall experience for individuals with diabetes. However, it's important to consider individual patient preferences and needs when selecting the most suitable insulin delivery method.

Conclusions

Modern fuel injection systems are developing in parallel with aftertreatment systems and the choice of aftertreatment technology is affecting the demands placed on the fuel injection system.Fuel systems will continue to have to be flexible, especially with regard to multiple injection capabilities. As injection quantities in the smaller injections reduce, so the accuracy of the injection, with regard to speed and repeatability of needle opening and closing will increase to ensure that injection to injection and injector to injector variability is minimised. Control systems functionality and power will also increase, not only as the functionality of the injection system increases, but also the requirements for controlling the total engine (including aftertreatment as well as on board diagnostics) also grow.

Thank you