**Project Statement**

Automated Syringe Loading Device

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**Team 2**

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**Statement of Need**

Diabetes is a metabolic disorder affecting millions of adults and children in America today. It is the result of the body’s failure to regulate blood sugar, though the use of its own insulin, either because the body cannot produce or properly use it. It is therefore the responsibility of a patient afflicted with diabetes to regulate insulin levels by monitoring their blood sugar, and manually injecting insulin from artificial resources.

While modern technology has made it relatively easy to monitor one’s own blood sugar with electronic devices, certain conditions that result from diabetes are still making the manual regulation difficult. It is not uncommon for someone with diabetes to develop low vision or blindness, low strength, poor hearing, and reduced motor control. These disabilities, among others, make filling a syringe with insulin to accurate levels.

**Basic Preliminary Requirements**

People with diabetes often develop other disabilities as a result. These disabilities can include, but are not limited to:

- hypoglycemia,
- cardiovascular disease,
- chronic kidney failure,
- inner ear failure,
- retinal damage, and
- nerve damage.

While diabetes can induce other disabilities, like comas, gangrene, and amputations, it is the last three on the list above that are currently of concern. Diabetes patients that suffer from retinal damage and nerve damage can have trouble filling a syringe with insulin when they need to. And those that have developed hearing problems may have trouble with audio-output devices.

An example of syringe loading devices is the “Count-a-Dose” syringe loader, made by Independent Living Aids, Inc. This device works by holding a syringe and an insulin bottle together, and making clicking noises as a user rotates a knob to fill the syringe. While this device is easy to use, has a low cost, and is helpful to patients, it does have some downfalls. The controls are still hard to see, the user may not be able to hear the clicking, and the adjustment knob still requires too much strength.

To create a syringe loading device that can be used by anyone with diabetes, especially those with limited motor control and poor vision, the following requirements must be met:

The device must

- fill the syringe accurately (to within 1/100 cc’s),
- inform the user how much insulin remains in the device reserves,
- keep a time stamped record of doses drawn,
- be digital with a voice output,
- accept any size insulin bottle,
- accept standard size disposable syringes,
- be accessible to users who are hard of hearing,
• be accessible to users who are blind or have poor vision,
• be easy to use by those with limited movement capabilities,
• be portable

**Basic Limitations**

The requirements of the design produce certain limitations for this device. Because it must be portable, it must be lightweight and of relatively small size (about the size and weight of a briefcase). The patients also have their own limitations that need to be addressed. To make it accessible for visually impaired patients, the displays must have bright, easy to see data readouts, along with bright and easily read controls. These controls should also include brailed. The voice output should come with a volume control for the patients who may have a hard time hearing. Also, the limitations presented by batteries exist. Batteries are heavy, but they need to have adequate energy reserves. Finally, safety limitations need to be considered. The syringes have sharp needles, the insulin reserves must be sterile, the device must ensure safe loading of the syringes (no bubbles) and children should not be able to access anything that could be harmful to them.

**Other Data**

In order to produce a device that can be used by anyone, a group or hypothetical patients was drawn up. The design process should consider each patient and their limitations. These patients are:

• Phyllis, a 77-year-old woman who suffers from arthritis. She has impaired hand strength, joint pains and joint stiffness. She also has macular degeneration and hearing loss, and prefers simple controls.
• Aaron, who is 23 with an arm amputation above the elbow, chronic neck pain and returning headaches.
• Keisha, an 84-year-old woman with hemiplegia on her right side. This was caused by a stroke, and affects her dominant hand. She also has had some memory loss that has continued to progress for the worse. She has hearing problems, and has had trouble with incontinence.
• Jerry, a gentleman who is 82 years old, has Parkinson’s disease which gives him tremors, rigidity, and decreased range of motion. He has also been experiencing Dementia.
• Jamie, a 42-year-old woman with a T11 spinal cord injury. She gets around in a wheelchair, and has urinary control problems.
• Betty, a 65-year-old woman has a bad hip that limits her lower extremity range of motion.
• Violet, a 32-year-old woman who takes blood pressure medicine.
• And Paul, a 43-year-old man with diabetes. His diabetes has caused neuropathy in his hands, has had two below-the-knee amputations and some loss of vision.
Questions

Some questions that need answering are:

- What environmental or legal restrictions exist?
- How will the device be packaged?
- How will the programming be done?
- Will the device be connected to a computer, or will it be self-contained?
- To what extent does the device need to be durable?
- How much do insulin containers vary in size?
- How much do syringes vary in size?
- What off-the-shelf components are available?
- To what extent does the device need to be child-proof?
Resources

