A NOVEL AUTOMATIC ECOGRAPHY PROCESS FOR PREGNANT WOMAN USING A COLLABORATIVE ROBOT

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I. INTRODUCTION

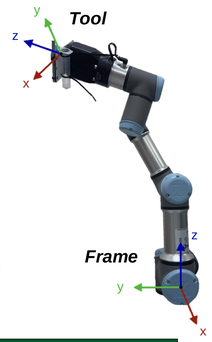
Echography is a standard monitoring technique for pregnancy. During the procedure, the expectant mother rests on an exam table while a gel is applied to her abdomen and a transducer is inserted into her vagina. The primary objective of this project is to automate the echography procedure for pregnant women by utilizing a collaborative robot to perform the task, monitoring in all the procedures the force applied to the patient's body in order to guarantee a safe practice.

II. MATERIALS AND METHODS

In order to perform the procedure, we have used the robot to replicate the movements carried out by the clinicians when performing an echography. To do so, we have implemented three main movements:

1. **General exploration movement:** In this movement, we have moved the transducer of the robot from one side to the belly to the other (from Right to Left).
2. **Zig-Zag movement:** Starting from the belly button, this movement consists of a zig-zag movement until the boundaries of the belly are reached.
3. **Pivoting movement**: Once localized the fetus in the belly, we pivot with the transducer to better visualize it and find the best point of view.

The following are some of the robot's specifications:



· **Tool:** In light of the laboratory's absence of authentic transducers, a bottle cap has been employed to simulate the instrument. The robot's vacuum capability ensures that the instrument is appropriately positioned for this task.

· **Force:** To regulate the magnitude of the force exerted by the robot during movement, a default force of 5 N has been established.

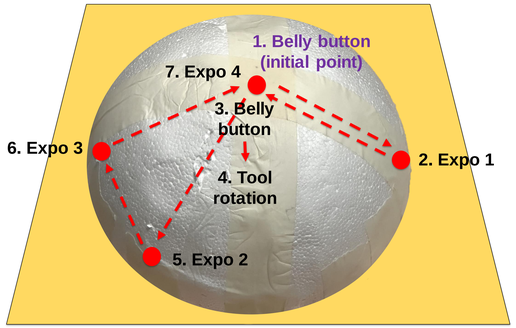
· **Frame:** The robot's frame has been positioned at the device's base.

Name	X	Y	Z	RX	RY	RZ
Tool (mm)	63.46	-88.62	117.45	0	0	0
Frame (mm)	-30.02	-389.9	237.97	2.243	-2.124	-0.036
Force (N)	0	0	5	0	0	0

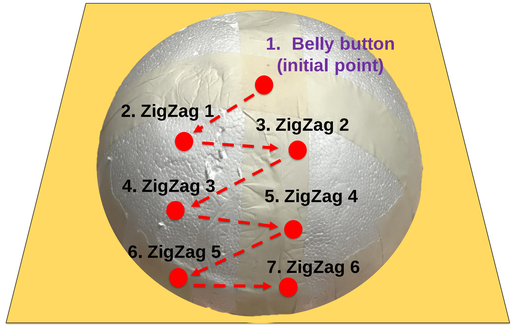
III. RESULTS

We have successfully executed the three movements delineated in Section II as an outcome of this undertaking. The subsequent are the movements, in addition to the various positions that they encompass:

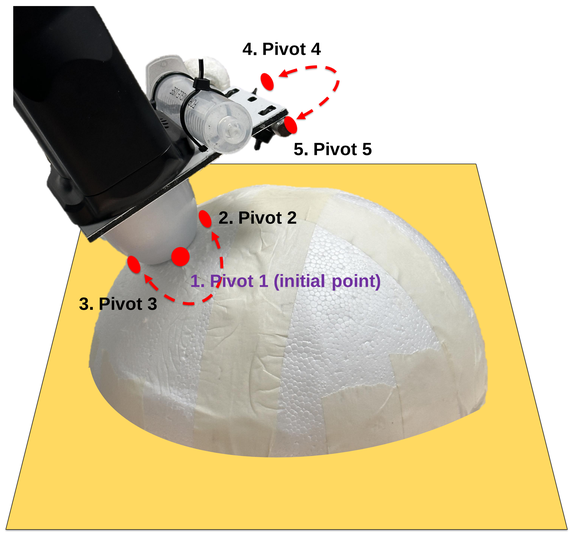
1. General Exploration Movement:



2. ZigZag Movement:



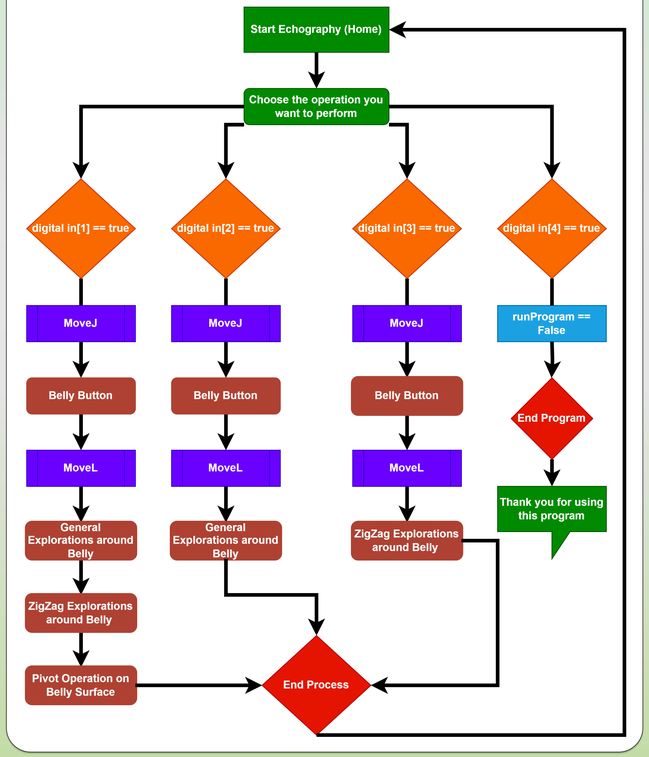
3. Pivoting Movement:



To successfully develop the movements of this project, we have utilized two main tools:

1. **Artificial Transducer (image 1):** A tool used to replicate a real transducer.
2. **Button control box (image 2):** This enables the execution of distinct programs in accordance with the button's state:
   - **Button 1** executes the whole program to perform General Exploration Movements + Zig Zag + Pivoting Movements.
   - **Button 2** executes only General Exploration Movements.
   - **Button 3** executes only Zig Zag Movements.
   - **Button 4** ends the program.

BLOCK DIAGRAM



CONCLUSIONS

Our project presents a universal robot designed to respond to various digital inputs with specific movement sequences, efficiently executing tasks from its base location. It is structured to handle three distinct scenarios, each activated by different inputs. Future enhancements include refining movement sequences for improved efficiency and expanding the input range for greater versatility. The project's potential extends to medical applications like echography, where robot simulations can lead to more precise, less invasive procedures, significantly benefiting patient outcomes.

REFERENCES

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