MICROPROCESSOR AND EMBEDDED SYSTEMS (22442)

FINAL PROJECT REPORT

3D Scanner

group number :29

Authors:

Abdullah Al-Momani	Abd20180776@std.psut.edu.jo	CE
Firas Hussein	Fir20160526@ std.psut.edu.jo	EE
Mayar Saidi	May20180782@ std.psut.edu.jo	NIS

Supervisor:

Dr. Belal Sababha.

January 21, 2024

Abstract

This project introduces a compact 3D scanner featuring a user-friendly design. It incorporates an IR range (distance) sensor and a lead screw mechanism, which is controlled by a NEMA 17 stepper motor. This configuration enables the sensor to move vertically, capturing detailed readings of an object positioned on a rotating platform.

Introduction and background

We will create a 3D scanner, which is allows the sensor to move vertically, capturing detailed readings of an object placed on a rotating platform.

In our project the machine should begin with the sensor descending to the base of the lead screw, halted by a limit switch. It then takes a reading of the object before the platform makes a minute rotation. This process repeats until a full rotation is completed, providing a comprehensive scan of the object's surface at that particular height

In addition to a voltage regulator, a micro-SD reader for data storage, and two A4988 stepper motor drivers for exact motor control, the project will make use of a PIC microcontroller for code design.

This 3D scanner is a useful tool for many purposes, from quality control to product development, as it promises to provide high-resolution 3D scans in a small, affordable package.
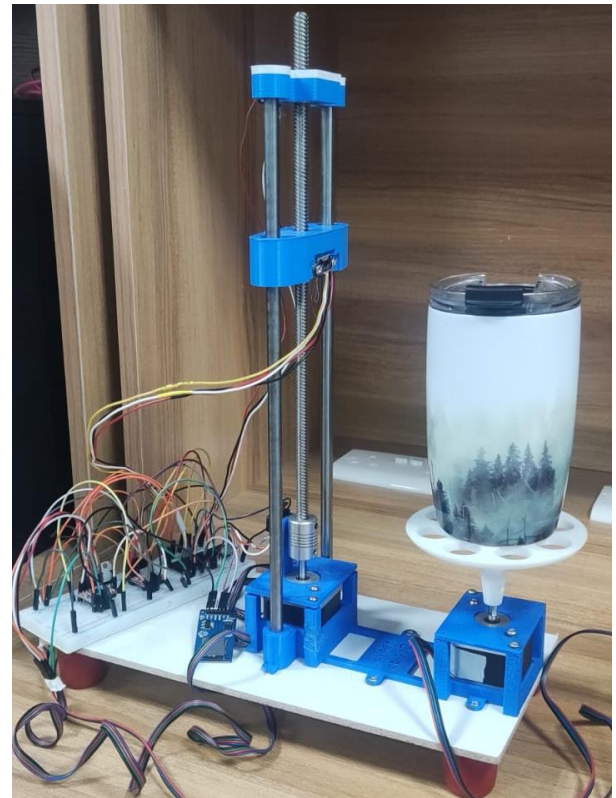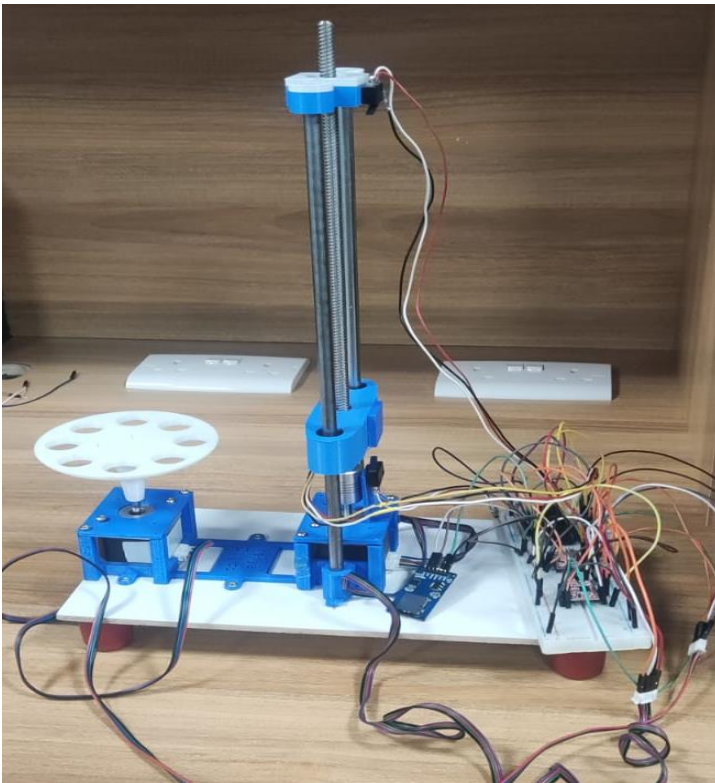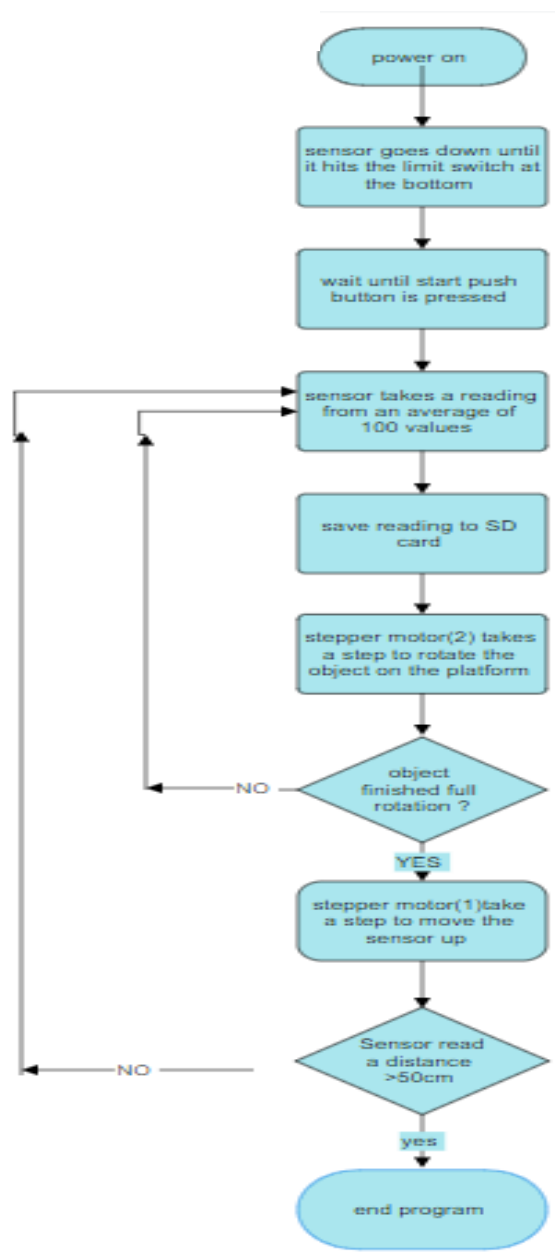
Design:

Electrical design:
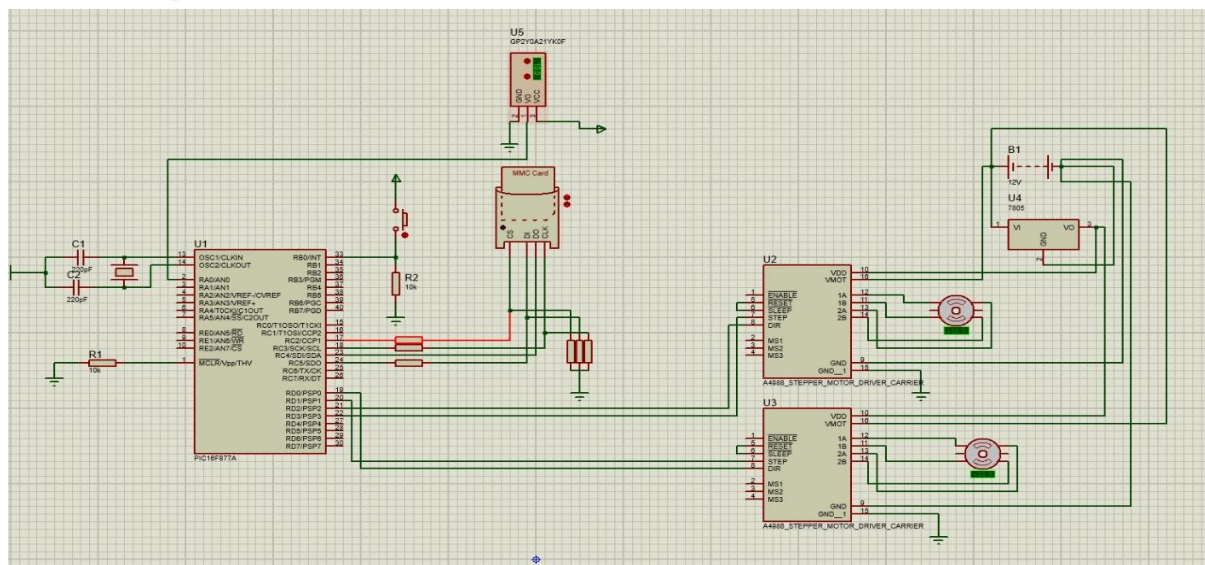
Mechanical design:
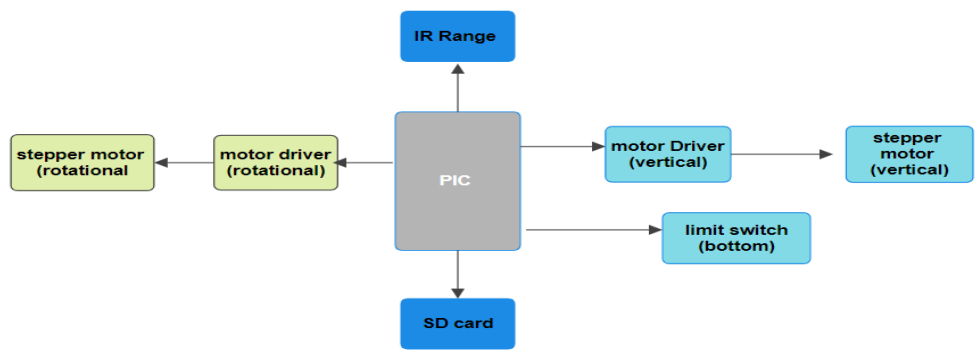
We will use these components:

1. IR range (distance) sensor
2. NEMA 17 Stepper Motor

3. A4988 Stepper Motor Driver

4. Limit Switches

5. Voltage Regulator

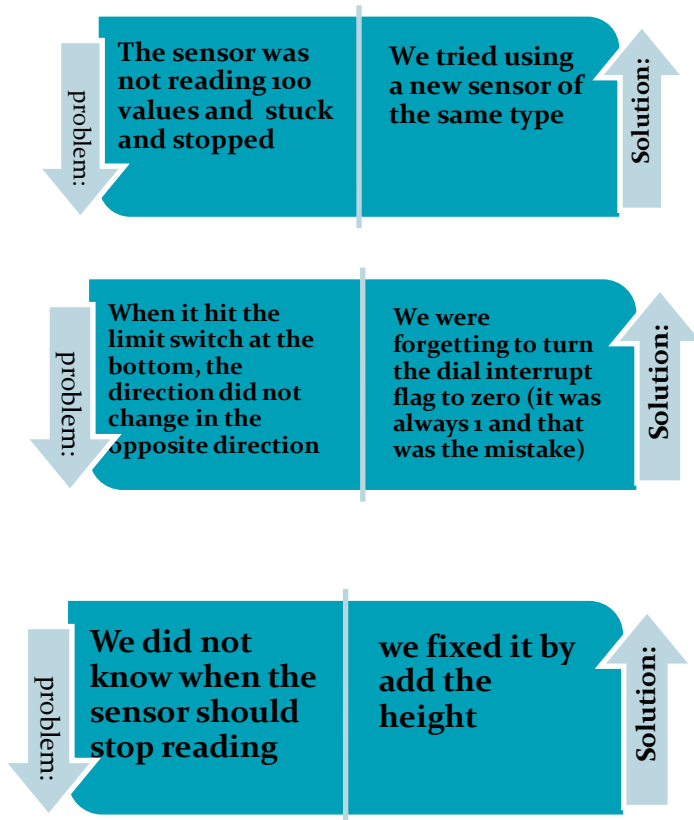6. Mini USB MicroSD Card Reader

7. Miscellaneous

Software design:

```
┌─────────────────┐
│    power on     │
└─────────────────┘
         │
         ▼
┌─────────────────────────┐
│ sensor goes down until  │
│ it hits the limit switch at │
│      the bottom         │
└─────────────────────────┘
         │
         ▼
┌─────────────────────────┐
│ wait until start push   │
│   button is pressed     │
└─────────────────────────┘
         │
         ▼
┌─────────────────────────┐
│ sensor takes a reading  │
│  from an average of     │
│      100 values         │
└─────────────────────────┘
         │
         ▼
┌─────────────────────────┐
│   save reading to SD    │
│         card            │
└─────────────────────────┘
         │
         ▼
┌─────────────────────────┐
│ stepper motor(2) takes  │
│ a step to rotate the    │
│  object on the platform │
└─────────────────────────┘
         │
         ▼
      ◇ object
     finished full      ──NO──►
      rotation ?
         │
        YES
         │
         ▼
┌─────────────────────────┐
│ stepper motor(1)take    │
│ a step to move the      │
│      sensor up          │
└─────────────────────────┘
         │
         ▼
      ◇ Sensor read
       a distance      ──NO──►
        >50cm
         │
        yes
         │
         ▼
┌─────────────────┐
│   end program   │
└─────────────────┘
```

Hardware design:

```
                         ┌──────────┐
                         │ IR Range │
                         └──────────┘
                              ▲
                              │
┌──────────────┐  ┌──────────────┐  ┌──────┐  ┌──────────────┐  ┌──────────────┐
│ stepper motor│◄─│ motor driver │◄─│ PIC  │─►│ motor Driver │─►│   stepper    │
│ (rotational  │  │ (rotational) │  │      │  │  (vertical)  │  │    motor     │
└──────────────┘  └──────────────┘  └──────┘  └──────────────┘  │  (vertical)  │
                              │  │                              └──────────────┘
                              │  └──────►┌──────────────┐
                              │          │ limit switch │
                              ▼          │   (bottom)   │
                         ┌──────────┐    └──────────────┘
                         │ SD card  │
                         └──────────┘
```

Problems and recommendations:

Software problems:

problem: The sensor was not reading 100 values and stuck and stopped

Solution: We tried using a new sensor of the same type

problem: When it hit the limit switch at the bottom, the direction did not change in the opposite direction

Solution: We were forgetting to turn the dial interrupt flag to zero (it was always 1 and that was the mistake)

problem: We did not know when the sensor should stop reading

Solution: we fixed it by add the height

Hardware problems:

We encountered an issue where the components were delicate, leading to the breakdown of more than one piece during manual handling. We suggest having some experience with sensitive components to minimize potential problems. The hardware posed numerous challenges, and we extend our heartfelt gratitude to the student Yahya Obeido for providing significant assistance with the mechanical design and 3D printing aspect of the project.

Conclusion:

Designing a 3D scanner was tough, as it demanded a solid grasp of embedded systems science and plenty of patience for trial and error. Despite the challenges, we're confident in our project. We believe it meets top-notch design standards and functions well.

References:

1. https://www.alldatasheet.com/

2.Stepper Motors: Types, Uses and Working Principle | Article | MPS (monolithicpower.com)

3. https://microcontrollerslab.com/stepper-motor-interfacing-pic16f877a-microcontroller

4.PSUT Elearning using chapter 8 and 9.