VILNIUS UNIVERSITY
FACULTY OF MATHEMATICS AND INFORMATICS
INSTITUTE OF COMPUTER SCIENCE
INFORMATION TECHNOLOGIES STUDY PROGRAM

Problem-Based Project

Rover

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Preface

This project was done during the 1st semester of the study programme *Information Technologies* in the specialization of Innovative studies. We chose the topic *Robot Companion* suggested during the project market on the first lecture of the subject ‘‘Problem-Based Project’’. The topic sounded very interesting as ...

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Abstract

Santrauka

Rover

Introduction

1 Analysis

To realize the robot companion project, we researched robots and robot kits available online, as well as referencing online videos on small robots. There were two major types of robots - those using arduinos, and those using a raspberry pi. We decided on utilizing a raspberry pi because we were more comfortable using Python than C++. There were numerous options for robots, namely, robot kits PiCar-X and PiCar-S v2 from Sunfounder, and FreeNove 4WD Smart Car. From our analysis, we noticed all of the robots and robot kits had many shared components: cameras, ultrasound sensors, wheels or tracks, motors, a raspberry pi, lithium ion batteries and other power components. From our analysis, we decided to keep all the main components from other robots, but focusing more on camera's obstacle detection rather than relying on sensors. Instead, we will use sensors as an aide to our cameras. Our reasons for this decision were ultrasound sensors being unpredictable, as well as them being loud. Furthermore, we chose a different type of motor than other robots because the robots we researched were able to move outdoors, while our robot is meant for indoor environments.

2 Functional requirements

To realize the project's vision the following functional requirements have been set:

- The robot will be able to move around the room, which includes moving forwards, backwards, and turning left and right.
- The robot will decide where to move by itself, without user input.
- The robot will be able to detect obstacles (objects in the robot's path – furniture, walls, etc.) that are in front of it and behind.
- The robot will make decisions on where to move when an obstacle is detected.
- If the robot cannot move due to an obstacle or error, it will inform the user using a sound signal.

3 Non-functional requirements

The robot will meet the following non-functional requirements:

- The robot will be operational until it runs out of power.
- The expected battery life is 2 hours.
- The robot will be easy to operate - it will be turned on and off with a button.

4 Implementation

4.1 Hardware components

The robot will be constructed using the following hardware:

- Raspberry Pi 4 Model B (4GB RAM version)
- (4) HC-SR04 ultrasound distance sensors
- (2) USB cameras
- (2) NEMA 17 stepper motors
- (2) DRV8825 stepper motor controllers
- Power switch
- Power bank
- (4) 18650 batteries
- 18650 battery holder
- (4) 1kΩ resistors
- (4) 2kΩ resistors
- (2) 100 μF capacitors
- Beeper
- 32GB MicroSD card

4.2 Hardware diagram

The robot's named components will follow the hardware diagram provided in Figure 1.

4.3 Software

The following technologies will be used to build the robot and maintain the required code:

- Linux OS
- Python
- OpenCV
- BASH
- Git

Conclusions and Recommendations

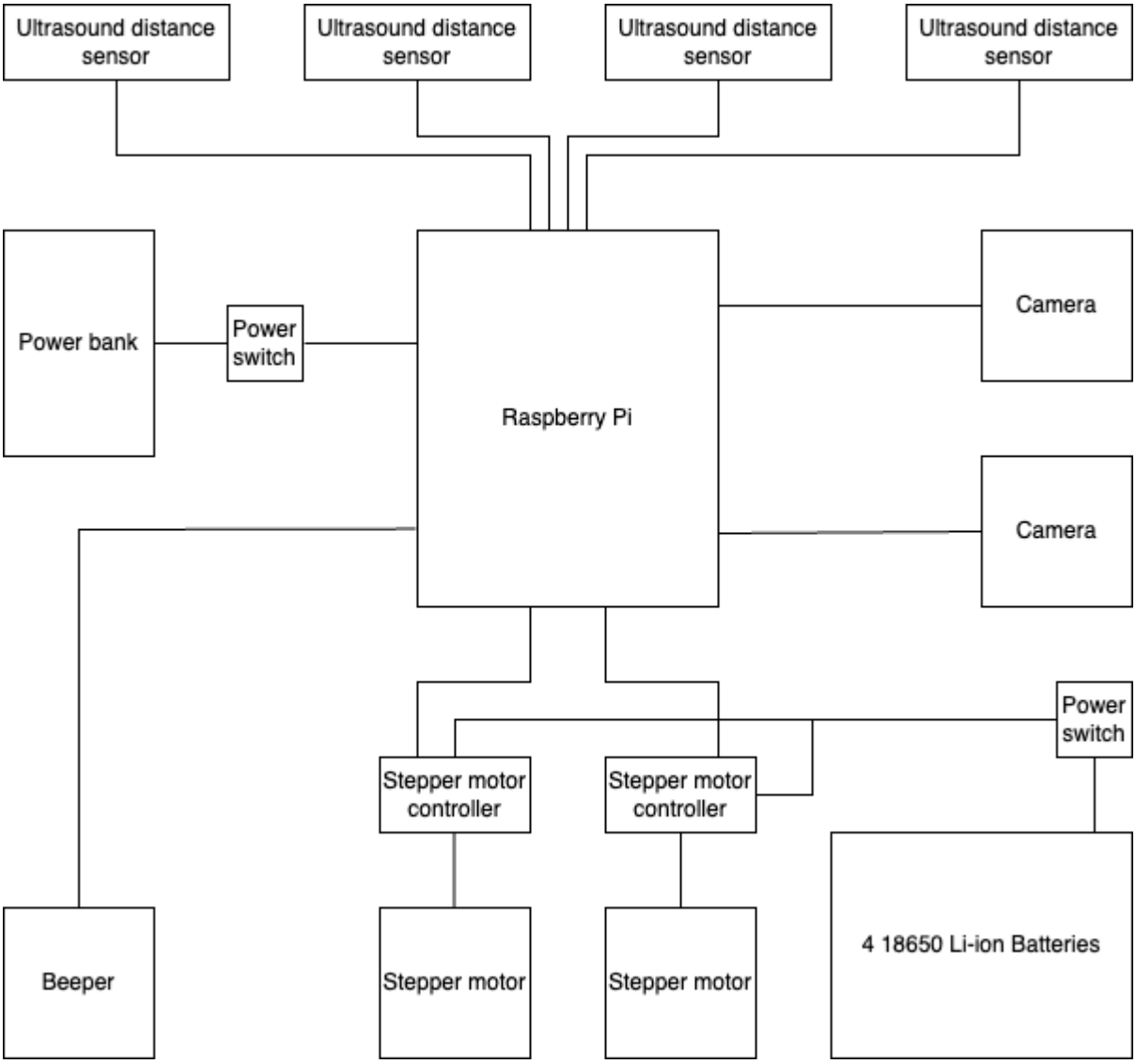

Figure 1. Hardware diagram