**Objectives**

1. Accuracy
2. Cost
3. Ease of use
4. Operation time
5. Power consumption
6. Robustness

**Functional Requirements**

**Motion in 2D directions**

Since the problem defined as mapping of a planar environment, our robot should move on ground plane.

**Determining self-positioning**

For this requirement, the device is supposed to determine its position during the operation.

**Measurement of environment**

The device is supposed to obtain the position information of the intended plane by taking measurements of the environment.

**Data processing and transmission**

In this requirement, the robot should projectile the measured data to given reference point and delivered to the user.

**Weighted Objective Tree**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Short Operation Time | Accuracy | Low Cost | Ease of use | Robust operation with changing environment | Low power consumption |
| 3 | <5 min | Understand how many objects are in field, their shapes properly and determine their positions correctly | <50 $ | User friendly GUI and live mapping | Works properly in laboratory and fair field for both dark and sunlight conditions | <10 W |
| 2 | 5-10 min | Understand how many objects are in field and their shapes properly, but cannot determine their positions correctly | 50-150 $ | User friendly GUI but long update duration of data | Works in laboratory everywhere but sometimes cannot operate properly on fair field ground | 10-20 W |
| 1 | 10-15 min | Understand how many objects are in field but cannot determine their position and shapes correctly | 150-200 $ | User friendly GUI presenting data transmission at the end of operation | Works only at specific conditions in laboratory | 20-50 W |
| 0 | >15 min | Number of objects, their shapes and their position cannot be determined correctly | >200 $ | No user-friendly GUI and no real time data processing | Sometimes works, but sometime does not work in any condition | >50 W |

**Operation Time:** This objective means the required time for finishing the mapping task.

**Accuracy**: how accurate our robot for tasks such as determining positions, shapes and number of objects. For now, we do not have ability to quantitate numbers for error rates since we have not made experiments yet. After experiments, we will also define some error range which are important for our project.

**Low Cost:** this objective is also important for us and we will try to reduce costs by determining our solutions.

**Ease of Use:** The GUI which will show us the map of the environment should be user friendly and if data processing is online, this is plus for our project.

**Robust Operation:** This is most important objective for us since we want our robot to operate in any environmental conditions.

**Low Power Consumption:** We will try to reduce power consumption as much as possible. This will reduce the cost and also will increase the expected lifetime of the device.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | Ideas |  |  |
| Motion in 2D Direction | Robot moves and scan the field randomly | Robot moves referring the boundary of the plane | Robot passes through the objects mainly referring to the boundary | Robot has complex algorithm that determines its shortest route |
| Self-Localization | Robot take reference as starting point and makes vector addition during motion | Robot takes references as the boundary of the plane | Robot uses GPS to position | Robot gets self-position by taking reference according to objects in the field |
| Objects Localization | Robot finds distance of objects using vector addition to reference point | Relative positioning according to surrounding objects in the plane | Robot finds its position by measuring position vectors from the boundaries. |  |
| Data Processing | Onboard processing and live updating of map | Map generation after all the measurements are taken |  |  |
| Processed Data Transfer | Output can be stored in a storage element and at the end of operation mapping output can be taken | Using Bluetooth, map can be transferred to screen | Using Wi-Fi, map can be transferred to screen | Using RF link, map can be transferred to screen |