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SLAM with Factor Graphs

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Introduction

Project description: Implementing Simultaneous Localization and Mapping (SLAM) using Factor Graphs

Project Goals:

- Creating a scientific library for factor graphs in GNU - GSL
- Practical implementation of the developed library on a marker based localization problem

User Stories

User story-01

Priority: High	**US01**	**Estimation: 3 week**
Requirement	As developers,	
	We want to create factor graphs using GTSAM	
	so that we can understand factor graph and the GTSAM library	
Acceptance criteria	The created factor graph should be able to take conditional probability statements as input and gives marginal probability as output	

User Stories

User story-02

Priority: High	**US02**	**Estimation: 3 week**
Requirement	As developers,	
	We want to build a custom library using GNU-GSL to generate factor graph	
	So that we can have my custom factor graph library for solving future problems in robotics	
Acceptance criteria	The created factor graph should be able to take conditional probability statements as input and gives marginal probability as output	

User Stories

User story-03

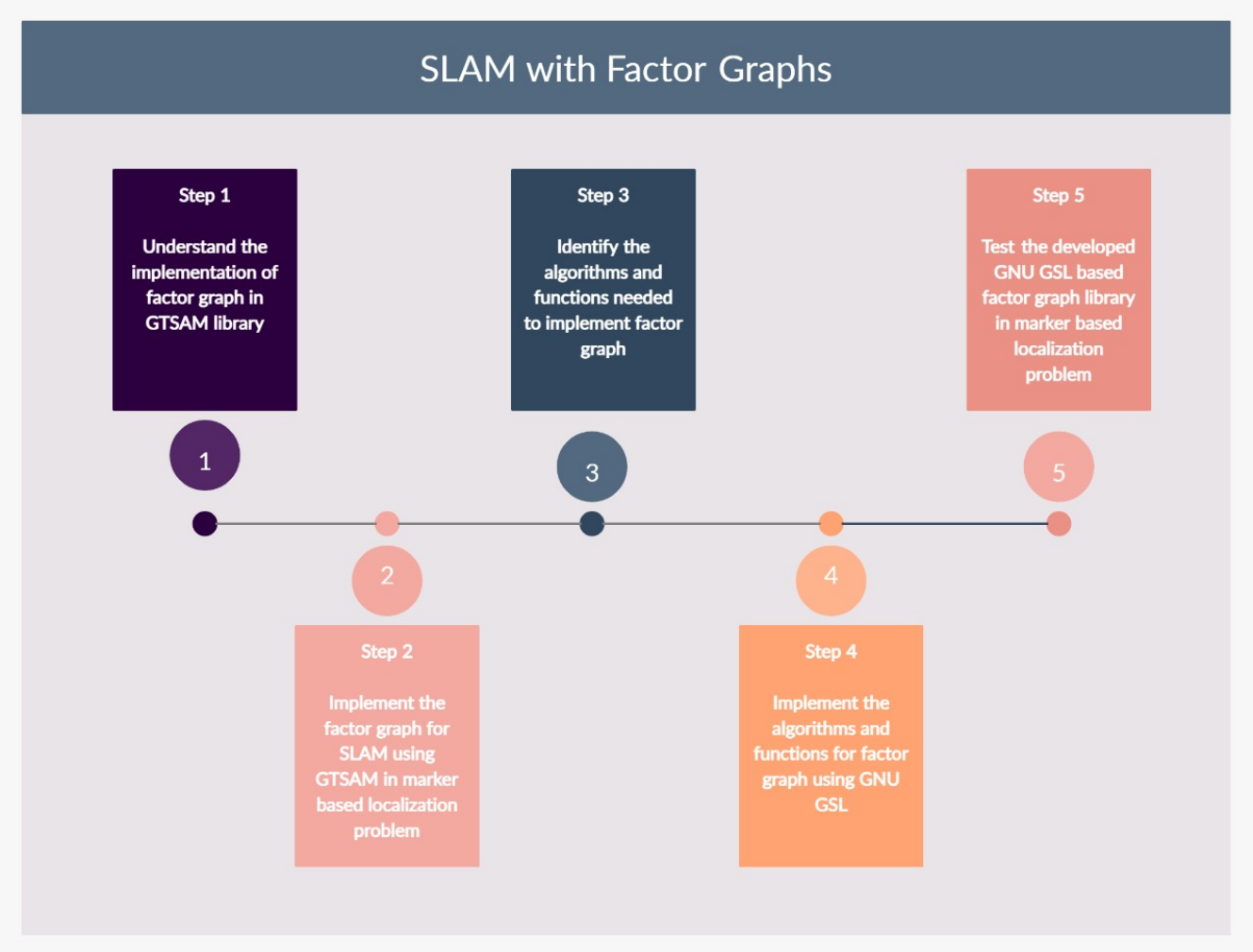
Priority: High	**US03**	**Estimation: 3 week**
Requirement	As developers,	
	We want to develop a message-passing algorithm	
	So that we can infer information from those factors between the nodes	
Acceptance criteria	The algorithm should be implemented in a way that it should update the factors from the observations	

User Stories

User story-04

Priority: High	**US04**	**Estimation: 1 week**
Requirement	As developers,	
	We want to build a library with functionalities for landmark based localization	
	So that we can localize the robot based on the aruco markers	
Acceptance criteria	Given that the position of the aruco markers are known, the implemented functionality should be able to perceive the aruco markers with the help of camera and estimate the position of the robot	

Process Workflow



Software development methodology

SCRUM process

- Goal/backlog setting for next sprint
- Retrospection of the past sprint
- Sprint Meetings
  - Meeting among developers to discuss what has been done/ongoing [10min]
  - Sprint meetings every three weeks with scrum master/coach [1hr]
    1. April 25
    2. May 16
    3. June 7
    4. June 27

Minimum viable prototype - features

- Able to create a factor(data structure) with variables and probability values.
- Able to add factors to form a factor graph based on the conditional and joint probabilities.
- Able to visualise the generated factor graph.
- Have functions to calculate factor product, factor marginalisation, factor reduction, joint distribution.
  1. Add or remove factor node
  2. Add or remove variables node
  3. Updating the factors
- Able to represent marker based localisation problems

Means of communication

- **Github:** Task assigning, maintaining to-do lists, documentation of meetings
- **Webex/offline:** For conducting sprint meetings and technical discussions

Tools and Technologies

Languages

- C, C++
- Python

Libraries

- GTSAM
- GNU - GSL