Localization and Visual Navigation of a Scalable Robot Swarm using ArUco Markers

by

Name	Roll No.	Registration No:
Swarnendu Sardar	**11700116026**	**161170110087** of 2016-2017
Sounak Mondal	**11700116035**	**161170110078** of 2016-2017
Soumik Dhar	**11700116039**	**161170110074** of 2016-2017
Arindam Samanta	**11700116098**	**161170110015** of 2016-2017

A comprehensive project report has been submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology

in

COMPUTER SCIENCE & ENGINEERING

Under the supervision of

Dr. Pramit Ghosh
Assistant Professor
Dept. of Computer Science & Engineering
RCC Institute of Information Technology

Department of Computer Science & Engineering
RCC INSTITUTE OF INFORMATION TECHNOLOGY
Affiliated to Maulana Abul Kalam Azad University of Technology, WestBengal
CANAL SOUTH ROAD, BELIAGHATA, KOLKATA – 700015

July, 2020

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
RCC INSTITUTE OF INFORMATION TECHNOLOGY

TO WHOM IT MAY CONCERN

I hereby recommend that the project entitled "**Localization and Visual Navigation of a Scalable Robot Swarm using ArUco Markers**" prepared under my supervision by Swarnendu Sardar (11700116026), Sounak Mondal (11700116035), Soumik Dhar (11700116039) and Arindam Samanta (11700116098) may be accepted in partial fulfillment of the requirements for B.Tech degree in **Computer Science & Engineering** from **Maulana Abul Kalam Azad University of Technology, West Bengal.**

.....
Project Supervisor
Department of Computer Science and Engineering
RCC Institute of Information Technology

Countersigned:

.....
Head
Department of Computer Sc. & Engg,
RCC Institute of Information Technology
Kolkata – 700015.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
RCC INSTITUTE OF INFORMATION TECHNOLOGY

CERTIFICATE OF APPROVAL

The foregoing Project is hereby accepted as a credible study of an engineering subject carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite to the degree for which it has been submitted. It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein, but approve the project only for the purpose for which it is submitted.

FINAL EXAMINATION FOR
EVALUATION OF PROJECT

1. .....

2. .....

3. .....

(Signature of Examiners)

ACKNOWLEDGEMENT

We would like to take this opportunity to express our profound gratitude and deep regards to our mentor – Dr. Pramit Ghosh who gave us the golden opportunity to work on this project and also for all his guidance, mentoring and constant encouragement throughout the course of this project.

We would also like to extend our gratitude to all the people for their direct or indirect involvement towards the completion of this project. Also, not to forget the coordinated efforts put forward by our work and hereby we thank each other for the successful completion of the documentation.

Arindam Samanta (CSE2016/081)

Sounak Mondal (CSE2016/083)

Soumik Dhar (CSE2016/084)

Swarnendu Sardar (CSE2016/087)

Abstract: This project deals with one of the most interesting problem in the field of robotics - localization and navigation of a mobile robot. The ability of a robot to find its location in the form of x and y coordinates in the 3D space or effectively in the 2D space and then finding its way to reach the destination is a very common problem and is also a very computation intensive and complex task. It has to take into account not just its own position relative to a reference point in the 2D space but also calculate the distance between the destination and its current position, as well as do the same for any obstacles that might come in its way. Not to mention the great applications that they provide, autonomous robot navigation can be used from regular household works to heavy duty industrial work.

Keywords: Localization, Navigation, Indoor Navigation Systems, Fiducial Markers, ArUco, Swarm Robotics

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

ArUco:	Augmented Reality University of Cordoba
Bot:	Robot
Nav:	Navigation
OpenCV:	Open Source Computer Vision library
VBL:	Vision Based Localization
MQTT:	Message Queuing Telemetry Transport
GPS:	Global Positioning System
TCP:	Transport Control Protocol
PID:	Proportional, Integral, Derivative
Contrib:	Contributor
2WD:	2-wheel drive
IoT:	Internet of Things
BO-motors:	Battery Operation motors
Li-ion:	Lithium-ion
Json:	JavaScript Object Notation
Lib:	Library
Rad:	Radian
AR-marker:	ArUco Marker
px:	Pixel
rvec:	Rotation vector
tvec:	Translation vector