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A Project Proposal on

Obstacle Avoiding Navigation Robot

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# Acknowledgement

First of all, we would like to extend our sincere gratitude towards the Department of Electronics and Computer Engineering, IOE Pulchowk Campus, for providing us this glorious opportunity to hone our instrumentation and programming skills by assigning us the task of building an electronic robot designed to address a specified task. We also express our warm regards towards the LOCUS committee of IOE, Pulchowk Campus for providing a national level platform to showcase our projects and building a motivating work environment by indulging the projects in the hardware competition of the exhibition. This self-practicing method of education is bound to familiarize us more with the tackling of real world problems, meanwhile, also enhancing our capabilities to work as a team. The project that we have proposed is an **Obstacle avoiding and navigating robot** that will find applications in delivery inside warehouses and factories, offices and restaurants, etc. We hope that you will like the initiation we are undertaking through the proposal of this project and approve us of our idea. We are also optimistic in receiving support and guidance through any difficulties we encounter in course of developing this project.

# Abstract

The main idea of this project is to build an automated obstacle avoiding and navigating robot. The robot will be based on wheels for motion and will be equipped with ultrasonic sensors, RF receivers, odometers, gyroscope, Bluetooth module and Arduino Microcontroller to guide it through the custom-made environment for navigation. The robot will be localized in the custom setting and programmed to reach a specific position within the setting from its current position. During this endeavor, it will have to avoid collision with any obstacles placed in its way by changing the course of its path and will stop once it reaches the specified destination. A robot of such functionality will find huge applications for future development in automating the delivery inside factories and warehouses, libraries, coffee shops and restaurants and also hospitals.

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# 1. Project Overview

This project is concerned with building an automated obstacle avoiding and navigating robot. The autonomy that the robot possesses will be fairly basic and dependent on the navigation data it obtains from the numerous peripherals interfaced to its microcontroller. Arduino Uno is proposed to be used as the microcontroller that will be the brain of the robot. However, as the project progresses, if situation arises where Arduino is incapable of computation or communication, a Raspberry Pi will be used in addition. The sensors that will be on-board in the robot are ultrasonic sensors for obstacle distance calculation, odometer and gyroscope to provide the sense of distance and orientation and one of RF receivers or BLE beacon Bluetooth receivers will be used as fit for localization.

A custom environment will be constructed as a field for robot navigation that will have obstacles in the form of boxes and the robot will have to make its way around it. The robot will communicate with a computer through either Bluetooth or Wi-Fi communication to receive the destination point within the field. Once fully functional, it will be able to guide past the boxes and reach the destination point hence performing an autonomous obstacle avoiding navigation.

# 2. Project Goals

1. Implement the hardware interfacing techniques taught in the Instrumentation II lectures.
2. Learn and execute the concepts of communication of data across different devices in wired as well as wireless forms.
3. Familiarize with the working of various electronic components such as servo motors, motor driver ICs, Bluetooth and wireless communication modules, etc.
4. Expand the programming and logical skills by using Arduino to perform logical and computational tasks for the robot.

# 3. Scope of the Project

The afore mentioned project has applications in various fields and also complies with the given theme ‘Smart City’. Currently, the carriage and delivery of heavy goods and machineries, hospital equipment, etc. are entirely manual in case of Nepal. A larger scale of this project will automate this sort of tasks and increase efficiency and safety. Some other useful scenarios to implement this project in the future are:

* Automated waiters serving in restaurants
* Document delivery robots inside offices
* Room servicing robots in hotels
* Delivery and carrier robots in warehouses

Furthermore, the project can also be expanded in the future by the addition of image processing and object detection features to make it more human-friendly and natural. It could then make logical decisions based on the results of the image processing. Similarly, advanced features like Deep Learning can be integrated with the project to make it fully autonomous as well.

# 4. Literature Review

The automation of tasks performed by human beings has been an age-old trend. Such automated robots have been proved handy in many scenarios where efficiency, safety or productivity are at stake. Factories and warehouses are perhaps the biggest users of robots as assistant to complete the given task. In a quest to build a sustainable, smart city, an autonomous robot plays a very important role. Moreover, an automated navigation robot will find countless applications as listed in the paragraph above. With all these concept in mind, the proposed project has been envisioned and hence designed. Moreover, the use of various electronic components for assistance to the robot makes the development of this project a great learning and experiencing platform in the field of Instrumentation and Robotics. An automated 4-wheel drive will require means of communicating with PC to get the asked destination, with the beacon senders to estimate its position in the locality and hence, it will also involve great deal of tinkering with communicating medias and protocols. When built with modular approach, this project also has the added advantage of expanding the features to make it more autonomous and adaptive to the surrounding in the near future.

# 5. Project Specifications

**5.1 Technical Description**

The project will utilize the following hardware components to complete the project. The list given below is an estimation of the components to be used. Their actual use may depend upon the necessity assessed as the project is developed. More equipment can also be added if the requirement arises:

|  |  |
| --- | --- |
| Equipment | Quantity |
| Arduino Uno Microcontroller | 1 |
| Ultrasonic sensors | 3 |
| Gyroscope | 1 |
| Bluetooth module | 1 |
| Odometer | 1 |
|  |  |
|  |  |

The above listed peripherals will be interfaced with the Arduino Uno and programming will be done to provide logic for the robot based on the data obtained from the interfaced sensors. For e.g, the ultrasonic sensors will give the distance from the upcoming obstacle and help to make the decision of turning left or right to avoid the obstacle. The gyroscope will give the information regarding the current angle or orientation of the robot and the odometer will be used to find the distance covered by the robot. Similarly, RF based transmitter and receivers will be used to localize the robot in the custom environment comparing signal strengths from different known positions.

# 5.2 System Block Diagram

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**Localization:**  
Estimate the robot’s position in the custom environment

**Bluetooth/Wi-Fi communication:**  
Gather the position of the destination from PC

**Gyroscope calibration:**  
Align the robot in the required orientation/angle to reach the target

**Task completion:**  
Stop once the position of the robot reaches the target position and send the success message back to PC

**Ultrasonic obstacle detection**   
While in motion, calculate distances to nearest obstacle and turn to avoid if necessary

# Expected Outcome

The following outcome is expected at the completion of the project within the provided timeline:

* The robot maneuvers turn to avoid the obstacles placed in front of it.
* It is able to estimate its position and orientation in the custom environment by localization.
* It receives the destination coordinate and moves to the asked location.