DESIGN OF PATH PLANNING ROBOT

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Abstract

Robot path planning and executing multiple times that task has been focused in this paper. Path planning is a key task in the field of Robotics. This requires embedding intelligence into these robots for ensuring optimal solutions for task execution. The modeling environment and algorithm to find the shortest, collision-free path are the basic issues in the path planning problem of the robot motion planning. Robotic is now gaining a lot of space in our daily life, several areas of modern industrial automation, and cyber-physical applications. Planning a path in a static environment is easy compared to a dynamic environment where the obstacles are moving. There is a need to develop such an effective technique for path planning in a dynamic environment. Thus, a lot of research problems that pertain to robotic applications have arisen such as planning (path, motion, and mission), task allocation problems, navigation, tracking. In this paper, we focused on the path planning research problem and solution

Keywords: Simultaneous Localization and Mapping, Path planning algorithm. Robotics, Embedded system, Encoder motor.

I. Introduction

Moving from one place to another is a trivial task for humans. One decides how to move in a split of a second. For a robot, such an elementary and basic task is a major challenge. In autonomous robotics, path planning is a central problem. The typical problem is to find a path for a robot, whether it is a vacuum cleaning robot, a robotic arm, or a magically flying object, from a starting position to a goal position safely. The problem consists of finding a path from a start position to a target position. This problem was addressed in multiple ways in the literature depending on the environment model, the type of robots, the nature of the application, etc. [3]. Safe and effective mobile robot navigation needs an efficient path planning algorithm since the quality of the generated path affects enormously the robotic application [5]. Typically, the minimization of the traveled distance is the principal objective of the navigation process as it influences the other metrics such as the processing time and energy consumption [4]. This paper presents a comprehensive overview of mobile robot global path planning and map learning. Path planning and map learning has been done using compass sensor and encoder. This data has stored in EEPROM and retrieved when robot is in action.

Nowadays, we are at the cusp of a revolution in robotics. A variety of robotic systems have been developed and they have shown their effectiveness in performing different kinds of tasks including smart home environments. Intelligence must be embedded into the robot to ensure optimal execution of the task under consideration and efficiently fulfil the mission. However, embedding intelligence into the robotic system imposes their solution to a huge number of research problems such as navigation which is one of the fundamental problems of mobile robotics [4]. we have focused on Map learning and Path planning.

II Problem Definition and literature

A service robot can be used for both domestic as well as industrial purpose. Some of the applications include cleaning and housekeeping, museum guidance, surveillance, etc. To achieve these tasks, an autonomous mobile robot must be capable of constructing and maintaining maps of their environment [1]. At the same time, the robot needs to localize itself using this map. This problem is usually referred to as Simultaneous Localization and Mapping (SLAM) and is a highly energetic area of research in the field of robotics [3]. The map-based navigation of a robot involves three processes (a) Map learning (b) Localization (c) Path planning. Map Learning - It is a process of memorizing the data acquired by the robot during searching, in a suitable representation. Localization - It is a process of deriving the current position of the robot within the map. Path planning - It is a process of choosing a course of action to reach a goal, from the current position. Various approaches, algorithms have been proposed for path planning are according to the environment, type of sensor, robot capabilities, etc. [2]. These approaches are gradually toward better performance in terms of time, distance, cost, and complexity. There are many types of algorithms to manipulate and search the data structure used to store the maps of the work area. Designing a code is a difficult part of this project because this project is a real-time application [7].

III System requirements and design

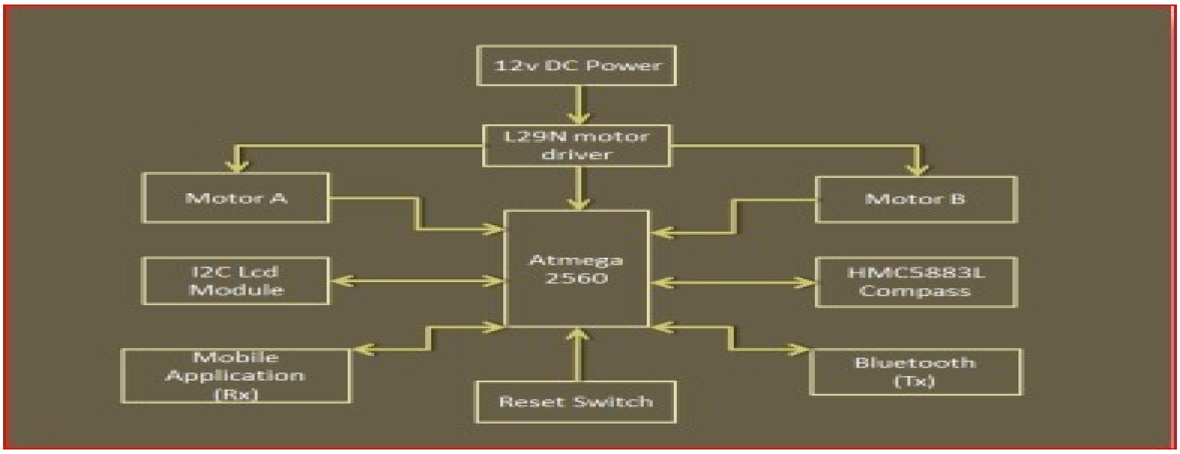


Figure 1 *Block diagram of Path planning robot*

Many hardware, software, and processing techniques are required in designing the proposed system. We have tried to implement an efficient technique for designing the robot. For robot path planning, there are number of sensors that can be used like laser range sensor, IR sensor, encoder, etc. Most widely IR circuits are designed on the principle of distance measurement. A transmitter sends a pulse of IR signals which is detected by the receiver if there is an obstacle and based on the angle the signal is received, distance is calculated. IR transceivers are very useful for distance measurement. But the accuracy of this sensor is lacking, when there is angular turn happens. An encoder is a sensor of mechanical motion that generates digital signals in response to motion [5]. As an electro-mechanical device, an encoder can provide motion control system users with information concerning position, velocity, and direction. We have used the HMC5883LDigital Compass

I **Software requirement**

Arduino integrated development environment (IDE) is a platform used to program our proposed system. Arduino group has developed this platform with an inbuilt compiler and a tendency to convert byte code into machine code which can be transferred to Arduino based microcontroller. The newer generation has added some new interaction with which we can program our SoC also. Arduino IDE creates a sketch with programming language like C++, it can be written with the help of programming language C also. The second software EAGLE is a scriptable electronic design automation application with schematic capture, printed circuit board layout, auto-router, and computer-aided manufacturing features. We have used EAGLE software for PCB designing.

II **Hardware requirement and system working**

Its hardware contains AT Mega 2560 is a Microcontroller, which has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 Analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller by simply connect it to a computer with a USB cable or power it with an AC-to DC adapter or battery to get started.
Mathematically equation to find a distance using encoder pules.

Circumference = pi * Diameter

Distance traveled = Wheel rotations * circumference
Distance traveled = (Encoder ticks / 360) * circumference
Encoder ticks = (360 / circumference) * Distance to travel

HMC5883L compass sensor: is a 3-axis digital compass used for two general purposes: to measure the magnetization of a magnetic material like a ferromagnet and to measure the strength. It measures the Earth's magnetic field value along the X, Y, and Z axes from milli-gauss to 8 gausses. Communication with the HMC5883L is simple and all done through an I2C interface. The breakout board includes the HMC5883L sensor and all filtering capacitors. The power and 2-wire interface pins are all broken out to a 0.1" pitch header. Uses the HMC5883Lmagnetometer chip. Supports 3.0V to 5.0V IO levels on I2C SCL and SDA pines.

The first task for the robot is to design the base part. In the base part, we choose the body part for robots and what is suitable for robots. The second task is to check the alignment of the body is right or not. Alignment is perfect then we move forward to the next part to choose wheels for the robot. Choosing wheels for the robot is an essential part and al wheels are the same and also grip and perimeter of wheels are the same

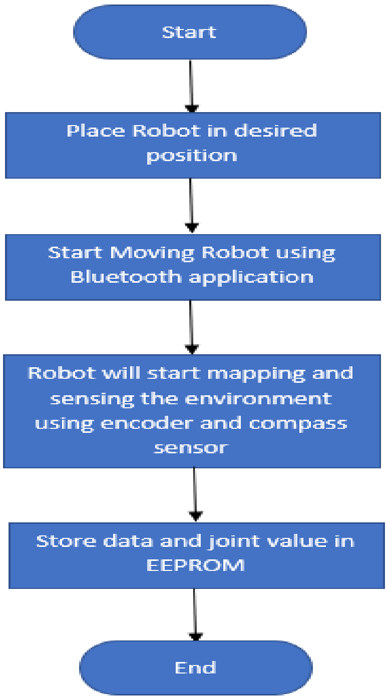


Figure 2 *Map learning algorithm*

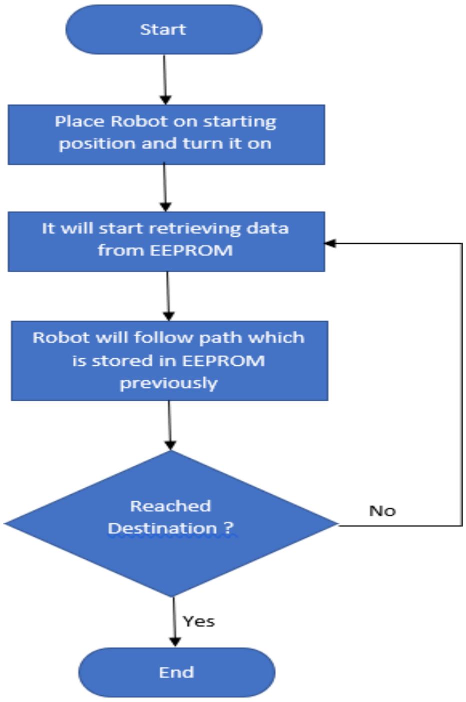


Figure 3 *Path planning algorithm*

Then we choose the DC motor according to our application, checked it if it working or not using a 12V battery power supply and then we connected the DC motor to the wheels. The basic task is completed making perfect body parts that fulfil our application. Then we move forward to the next part.

In this part, we choose components of our robot according to our application and components list below

- AT mega 2560
- L29N Motor Driver
- HMC5883L Digital Compass
- Bluetooth
- I2C LCD 1602
- Encoder motor

Assemble the above list of components and check all components are working or not. We connect all components to the controller. Here, the important part is what logic satisfying our application, and we design code in Arduino software. Write a code is a difficult part of this project because this project is a real-time application and in which sensors and motors outputs are not continuously similar when the 12V power supply battery is not fully charged. We observed that when a battery is not fully charged, DC motor speed is varying according to the previous result. According to the result, we change the code and make a perfect result for our project. Afterward, the software programming part comes and programming is done in Arduino IDE with the C programming language. For storing data, we use an EEPROM memory in our application. The ATmega32 contains 1024 bytes of data EEPROM memory. It is organized as separate data space. Data bytes are addressed 0 to 1024. System implementation starts with hardware design after proper testing on a breadboard. PCB designing process will be done with the help of EAGLE Autodesk by selecting the proper component and libraries

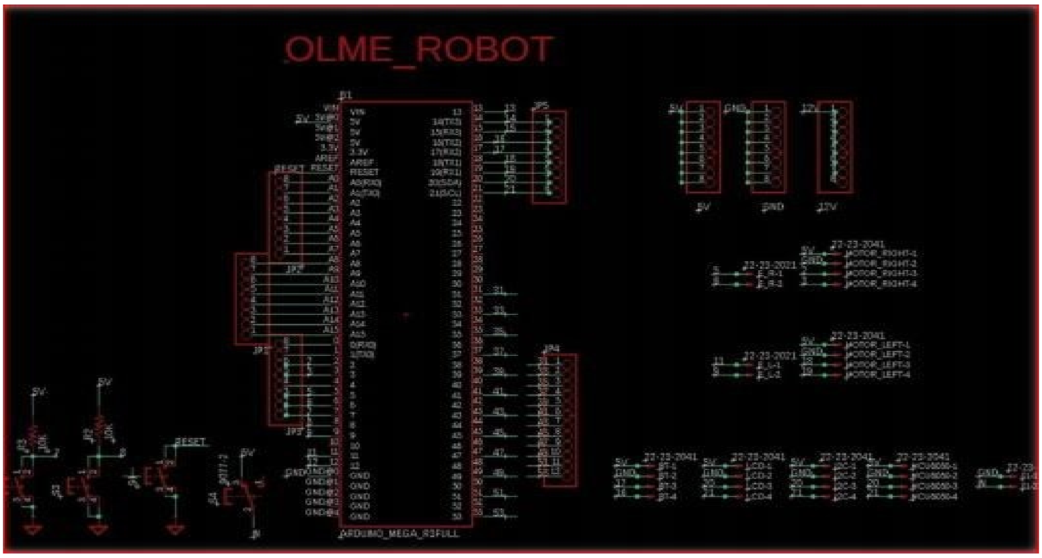


Figure 4. *Schematic Diagram*

The above mention schematic diagram (Figure 5.) is designed and then it's converted into ". brd" file. The layout file has been created with a proper place and route. This PCB has been soldered with pre-identified components. Although AutoRoute is very useful in quickly laying out traces but it's not perfect, so manual routing has been done for efficient design. For fabrication using chemical etching, we required a mask that will be used to expose the pre-etched core to ultraviolet radiation that transfers our layout design to the top layer. A typical method for accomplishing this is to use a printer and print our design onto transparency. We have to be sure to use the correct settings on our printer, with the correct type of transparency, otherwise, we could seriously damage the printer. The first step is to make sure; your board passes DRC and to double-check the schematic of designs to make sure that there are no missing or extra components. In a chemical etching we use an H2SO4, FECL and H2O.we have mixed a 50% H2SO4 and FECL and 50% H2O in one biker and then put our printed PCB into this biker. After 10 min tack, our PCB into this biker and clean with the cotton cloth. Generally, we use an iron to print a carbon copy of a layout.

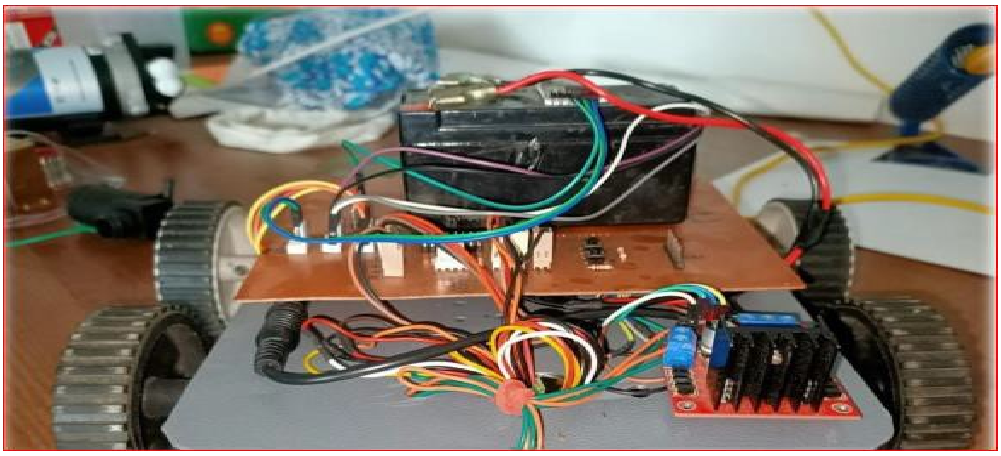
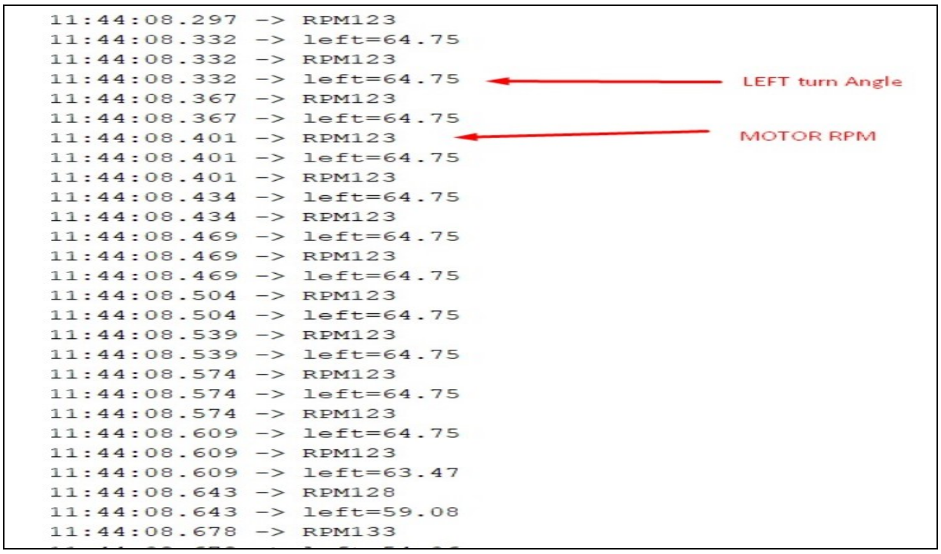
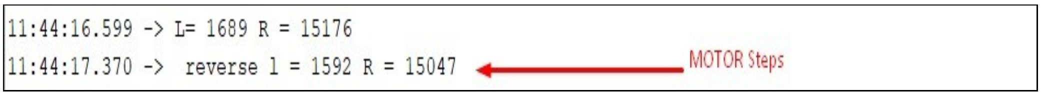


Figure 5. *Path planning ROBO*

As we know real-time application kind of project takes many tries to reach final output, so our project takes many trial and error. The robot with the moving object can face many problems like path obstacles, low battery power, etc. We use Bluetooth HC-05 to provide serial communication between the controller of the transmitter and the smartphone by using the app, which is developed by Bluetooth robot car controller app inventor. Using the Application, we can send the direction of a signal to provide the communication between the transmitter and receiver as a mobile phone. We are using Bluetooth on both sides of the network, which provides a range of up to 10 meters, and supported baud rate of 600 to 460800. At the receiver part, mobile receive the value of the direction signals which has established the serial communication between the mobile Bluetooth and microcontroller. The transmitter and receiver are the last tasks of the project. All the components and code are ready, then output is depending on the transmitted and received signal [3].

IV Results and Conclusion





The algorithm is designed to planning of paths in high-dimensional spaces and can be applied to robots with many degrees of freedom in static environments. In this experiment Encoder motor with compass sensor and Bluetooth connectivity are designed and developed to detect and determine the direction of the path and to move the robot to the desired place on the bases of path planning algorithms. HMC5883L compass sensor is very easy to use it in conjunction with microcontrollers due to I2C and SPI interfaces. Using the mobile application, we control the robot. The first time the robot starts moving and covers the path. In the end, press the stop button. This covered path is stored in the controller and also the controller is reset but the stored data is not erased. Then the robot can run multiple times on the same path and we achieved our final output. We can store one or more data paths in this algorithm. Then the robot can run multiple times on same path. This robot can be used in hospitals, manufacturing companies, and the medical field.

V. Future work

We can forecast with some degree of accuracy how the ongoing uptake of robots will affect industries, business models, jobs, and workers over the next 10 years. In this section, we look at the current state of robot implementation in three core industry sectors – manufacturing, logistics, and healthcare. robot adoption continues to increase globally. In this era of robotics, we can add some new path planning algorithms in a dynamic environment and create new purpose robots which will be helpful in all industries where robots are working. Mobile robot encountering any dynamic obstacles when traveling from the starting position to the desired goal according to the optimum collision-free path determined by the controller [4]. The controller should be capable of re- planning the new optimum collision-free path [6]. For designing, we can also use SoC, an advanced sensor like MaxBotix Ultrasonic Sensors. For path storage, we can use cloud storage.

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