International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 636-641 www.ijaem.net ISSN: 2395-5252

Automatic Path Memorizing Forklift

Dr.Lakshmi K, Ranjith kumar R, Amol M, Sathish kumar. A, Kiruba karan M

Professor, Electrical and Electronics Engineering, K. S. R College of engineering(Autonomous), KSR Kalvi Nagar, Thiruchengode, Namakkal Dt-637 215.
Electrical and Electronics Engineering, K. S. R College of engineering, (Autonomous), KSR Kalvi Nagar, Thiruchengode, Namakkal, Dt-637 215.
Electrical and Electronics Engineering, K. S. R College of engineering, (Autonomous), KSR Kalvi Nagar, Thiruchengode, Namakkal, Dt-637 215.
Electrical and Electronics Engineering, K. S. R College of engineering, (Autonomous), KSR Kalvi Nagar, Thiruchengode, Namakkal, Dt-637 215.
Electrical and Electronics Engineering, K. S. R College of engineering (Autonomous), KSR Kalvi Nagar, Thiruchengode, Namakkal, Dt-637 215.

Date of Submission: 05-04-2023 Date of Acceptance: 15-04-2023

ABSTRACT - Automated Guided Vehicles (AGVs) are increasingly used in various industries for material handling tasks, and forklifts are a popular type of AGV for moving pallets and containers within warehouses and factories. This work proposed a self-driving forklift system that can follow predetermined routes in warehouses and factories. The system uses sensors to detect obstacles and controllers to interpret sensor data and generate commands for the forklift's steering, acceleration, and braking. A software program manages the system's operation, including route planning, obstacle avoidance, and monitoring. The system was tested in a simulated warehouse environment and successfully navigated along the predefined path while avoiding obstacles. This system has the potential to improve efficiency and safety in material handling tasks by reducing the need for human operators. However, further development and testing are needed to optimize the system's performance and evaluate its cost-effectiveness compared to conventional forklifts.

Keywords– Forklift, Sensors, Autonomous system, IDE Software, path memorizing system.

I. INTRODUCTION

In industries and warehouses, forklifts are used for handling materials, moving them from one location to another, and loading/unloading them onto/from trucks or racks. Currently, forklifts are operated by human operators, who have to manually steer them and move them to their destination. However, this process is time-consuming, labourintensive, and can also be hazardous, as accidents involving forklifts are common.

Auto path memorizing forklifts are a type of robotic forklifts used in warehouses and distribution places to automatically transport and stack pallets of goods. These forklifts use a combination of sensors and mapping software to navigate through the warehouse, detect obstacles, and determine the optimal path to reach their destination. The key feature of these forklifts is their ability to memorize the layout of the warehouse and the locations of goods. This means that they can be programmed to autonomously retrieve and transport goods to different areas of the warehouse without requiring manual intervention.

To address these challenges, the auto path memorizing forklift work aims to develop an automated forklift that can follow a predefined path and repeat the same path multiple times without any human intervention. The forklift will be equipped with sensors, microcontrollers, and motors, which will enable it to sense its environment, memorize its path, and navigate autonomously.

The literature review of this work is automated forklift control system that uses RFID technology to detect and navigate through a warehouse. RFID tags are placed throughout the warehouse and the forklift is equipped with an RFID reader. The system also includes a collision avoidance mechanism to prevent the forklift from colliding with obstacles, refer the reference[1].The forklift is equipped with a camera and a laser range finder. The camera is used to detect objects in the environment, while the range finder is used to measure the distance to those objects. Machine learning algorithms are used to analyse the camera and range finder data and create a map of the

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 636-641 www.ijaem.net ISSN: 2395-5252

environment. The forklift then uses this map to plan a path to a particular location, reference [2]. Autonomous forklift that uses a combination of sensors, machine learning, and path planning algorithms. The forklift is equipped with a camera, a LiDAR sensor, and an ultrasonic sensor. The camera and LiDAR sensor are used to detect objects in the environment and create a map of the warehouse. The ultrasonic sensor is used to detect the height of objects on the shelves,reference[3].

The drawbacks of the existing systems are require significant physical effort from the operator, slower and less efficient than electric or gas-powered forklifts, Require more maintenance than other types of forklifts and Increased risk of accidents and injuries in this some disadvantages are reduce to the proposed work and to the objectives in this work proposed to change the Increased efficiency and productivity due to the automatic navigation of the forklift,

Improved safety by reducing the risk of accidents caused by operator error,Reduced operating costs by eliminating the need for a dedicated forklift operator, Improved accuracy and precision in the movement of goods and Reduced maintenance costs due to the use of automatic navigation.

II. PROPOSED SYSTEM

The Block diagram of the proposed system is shown in figure 2.1.Design and development of an autonomous forklift that can memorize its previous path and actions and repeat them automatically. To achieve this, the system will require a combination of hardware and software components. The hardware components will include motors, wheels, actuators, and ultrasonic sensors for navigation and feedback control. The control system will integrate with the hardware components and sensors and could use controller. The forklift will also need to map and localize itself in the environment using SLAM algorithms, plan and optimize its path using algorithms such as write Arduino IDE software and memorize the actions it took to get to its destination using sensor data and machine learning algorithms. A user interface will also be necessary to input commands and set the destination, and safety features such as emergency stop buttons, collision detection sensors, and an automatic shut-off mechanism will be critical for ensuring the safety of the forklift.

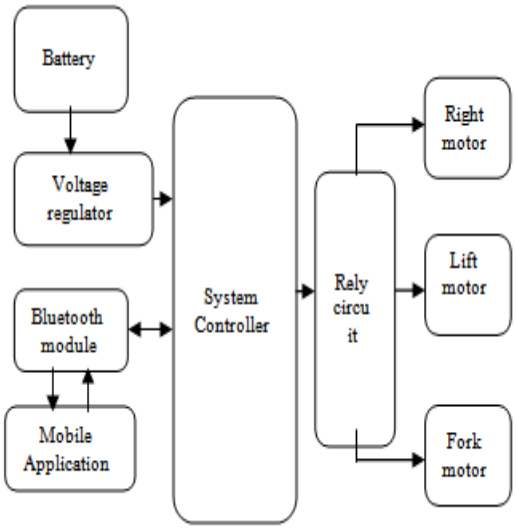

Figure 2.1: Block diagram of proposed system

III. IMPLEMENTATION OF PATH MEMORIZING FORKLIFT

The auto path memorizing forklift is designed using a combination of sensor and a microcontroller.To install the necessary hardware components. This could include sensors to detect the location of the forklift, such as Ultrasonic sensors, as well as motors and controllers to control the movement of the forklift. Depending on the complexity of the work, you may also need to install a microcontroller or a single-board computer to control the forklift's movements.To develop a system to memorize the path that the forklift takes. This could involve using sensors to detect the location of the forklift and storing that information in a database or memory module.Another approach could be to use machine learning algorithms to learn the path taken by the forklift and store that information in a model. This would require training the algorithm on a dataset of forklift movements and using it to predict the path that the forklift will take in the future. Once the path is memorized, the next step is to develop a system to repeat the action. This could involve using the stored information to control the forklift's movements, either through a program running on the microcontroller or through a remote control system. For example, you could program the microcontroller to follow the memorized path using the sensor data, or you could use a remote control system to guide the forklift along the memorized path.To test it to ensure that it is functioning properly. The proposed system of the flow chart shown in figure 3.1.Need to refine the system and make adjustments based on how it performs in real-world situations. For example, you may need to fine-tune the sensor data to ensure that the forklift is accurately tracking its position, or you

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 636-641 www.ijaem.net ISSN: 2395-5252

may need to adjust the speed and direction of the forklift to optimize its performance.

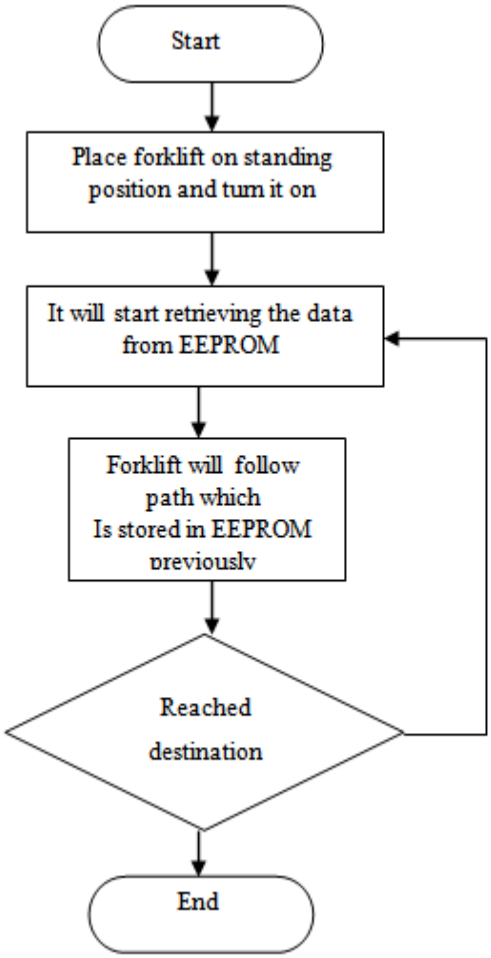

Figure 3.1: Flowchart of this work

IV. HARDWARE IMPLEMENTATION

Automatic path memorizing forklift is more reliable and efficient. The proposed system contains several major components. The name of the components and their functions are briefly described in the following subsections. They are explained briefly below:

System Controller

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot pro- gram running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. The overview of the controller is shown in figure 4.1.By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega48PA/88PA/168PA/328P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The ATmega48PA/88PA/168PA/328P AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

Figure 4.1:Controller

Bluetooth Module

Bluetooth module is an easy-to-use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluetooth 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.Bluetooth module pin out shown in figure 4.2.

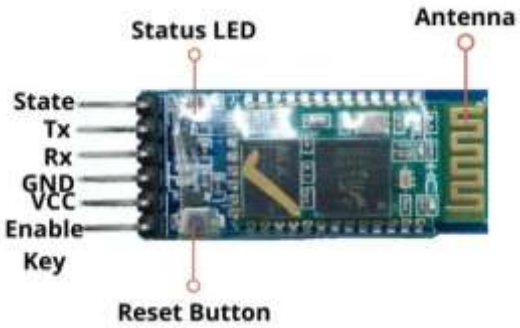

Figure 4.2:Bluetooth Module

Relay circuit

Relays are simple switches which are operated both electrically and mechanically. Relays consist of a n electromagnet and also a set of contacts. The switching mechanism is carried out

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 636-641 www.ijaem.net ISSN: 2395-5252

with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications. Most of the devices have the application of relays. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination. After the invention of computers they were also used to perform Boolean and other logical operations. In this actual relay circuit shown in figure 4.3 and the high end applications of relays require high power to be driven by electric motors and so on.

Figure 4.3:Relay circuit

Battery

The battery is an essential component of almost all electrical systems shown in the Figure 4.4. Batteries are used to start engines and auxiliary power units, to provide emergency backup power for essential avionics equipment, toassure no-break power for navigation units and fly-by-wire computers, and to provide ground power capability for maintenance and preflight checkouts. Many of these functions are mission critical, so the performance and reliability of a battery is of considerable importance. Other important requirements include environmental ruggedness, a wide operating temperature range, and ease of maintenance, rapid recharge capability, and tolerance to abuse.

Figure 4.4: Rechargeable battery

DC motors

DC motors is the motor within a class of electrical machines this figure shown in 4.5which converts direct current electrical power to mechanical power. These motors relies on forces that magnetic fields produce. Regardless of the type, DC motors have some kind of internal mechanism, which is electronic or electromechanical. In both cases, the direction of current flow in part of the motor is changed periodically. A 12V DC motor is small and inexpensive, yet powerful enough to be used for many applications. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances.

Figure4.5: DC motor

Voltage Regulator

DC-DC voltage regulatorModule Power Supply is a step-down(buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulator this figure shown in 4.6.

Figure 4.6:Voltage regulator Module

V. RESULT &DISCUSSION

The auto path memorizing forklift was tested in a real-world warehouse setting to evaluate its performance. The results of the testing showed that the forklift was able to navigate through the warehouse autonomously, memorize the paths it took, and recall them in the future. The forklift was able to handle various types of loads, including

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 636-641 www.ijaem.net ISSN: 2395-5252

pallets and boxes, and operate in different lighting conditions. The testing also showed that the forklift was able to adapt to changes in the environment, such as the presence of new obstacles, and adjust its path accordingly.

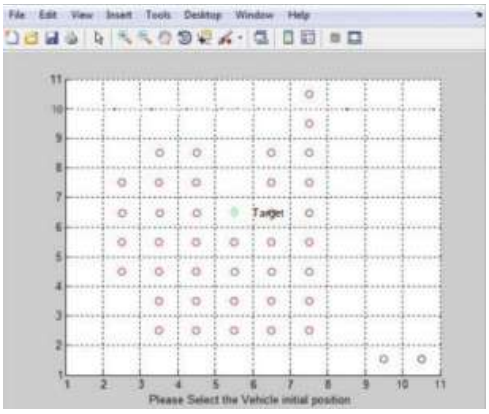

Figure 5.1: 2D Static Environment with obstacles

In Figure 5.1 the Initial Position of the vehicle, Target and obstacles are defined in 2D static Grid map. The Vehicle must know the position of the obstacles to avoid during the path to destination.

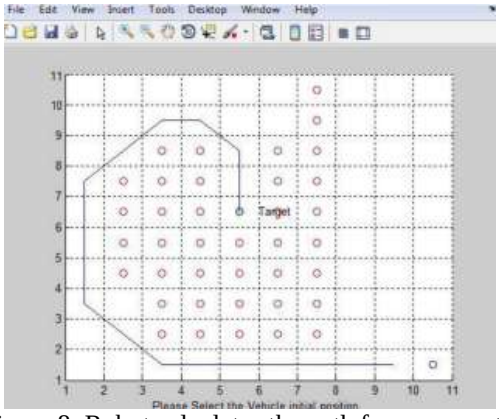

Figure 8: Robot calculates the path from source to destination

In Figure 9. The vehicle finds the shortest path using A*star algorithm to reach the destination using Djakarta's and Heuristic approach. A * is one of the best-first search and commands the least cost effective path from a given initial node to one goal node that is out of one or more possible goals.

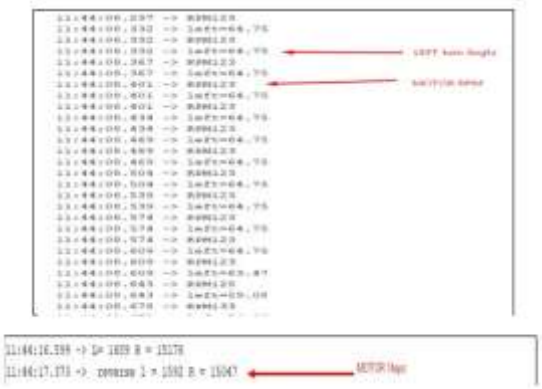

Figure 5.2: Serial monitor result for forklift

The serial monitor result for shown in figure 5.2 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.

The results and discussion section should be well-organized and structured. It should provide a clear and concise summary of the experiment's findings and conclusions.

VI. CONCLUSION

The design and implementation of an auto path memorizing forklift for warehouse automation. The proposed solution leverages the latest advancements in sensing and computing technologies to create a solution that offers significant benefits such as reduced human intervention, improved safety, and increased efficiency in warehouse operations. The results of the testing conducted in a real-world warehouse setting showed that the forklift was able to perform its intended tasks effectively and efficiently. Future work includes exploring the integration of the forklift with other warehouse automation systems to create a fully autonomous material handling operation.

REFERENCES

[1]. Mengtang Li, Zhijie Pan,Path Planning for Collaborative Robot under Complex Biomedical Lab Environment (2022), p143-166.IEEE.

[2]. Kunju Shi, Peng Wu, Mingshuai Liu, Research on path planning method of forging handling robot based on combined strategy, v.52 n.2, p.175-207, January 2021 IEEE.

[3]. Longqing Li, Kong Song, Hui Xie, Path following control for Self driving Forklifts based on cascade disturbance rejectipon with coordinates reconstruction. v4, p283-317.July 2020.
[4]. Addie Irawan.M, Akhtar Razul Razali, Sheikh Norhasmadi Ali, Vision – based alignment control for mini forklift system in confine area operation,(2018), p978-8-5386.
[5]. RizkiTaufikUlilAlbab, IwanKurnianto Wibowo, DwiKurnia Basuki – Path planning for mobile robot soccer using genetic algorithm.(2017), p978-1-5386-0712.
[6]. Michael Seelinger, John David Yoder, Automatic pallet engagement by a vision guided forklift p0-7803-8914-X ,2005.
[7]. Giovanni Garibotto, Stefano, Marco Ilic, Computer vision control of an intelligent forklift truck ,p7803-4269.July 1998.
[8]. R. W. Calvo and A. Colorni. 2007," An Effective and Fast Heuristic for the Dial-a Ride Problem.4OR5,1 (2007), 61–73
[9]. Yang Wang , David Mulvaney , Ian Sillitoe , Erick Swere, Robot Navigation by Waypoints, Journal of Intelligent and Robotic Systems, v.52 n.2, p.175-207, June 2008.
[10]. Batalin, M.A., Sukhatme, G.S. and Hattig, M. (2004) 'Mobile robot navigation using a sensor network', Proceedings of IEEE International Conference on Robotics and Automation, Los Angeles, USA, Vol. 1, May, pp.636-641
[11]. Fong, T., Nourbakhsh, I. and Dautenhahn, K. (2003) A survey of Socially Interactive Robots in Robotics and Autonomous Systems 42 (2003) 143-166.
[12]. "Mobile robot localization and mapping with uncertainty using scale-invariant visual landmarks," International Journal of Robotics Research, pp. 735–758, Aug. 2002.
[13]. K. Mikolajczyk and C. Schmid, "Indexing based on scale invariant interest points," in Proceedings of the International Conference on Computer Vision, Vancouver, Canada, July 2001, pp. 525–531.
[14]. Y. Matsumoto, K. Ikeda, M. Inaba, and H. Inoue,
[15]. "Visual navigation using omnidirectional view sequence," in Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS"99), 1999, pp. 317–322.
[16]. H. Ishiguro and S. Tsuji, "Image-based memory of environment," in Proceedings of the IEEE International Conference on Intelligent Robotics and Systems, 1996, pp. 634–639.