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RESEARCH ARTICLE OPEN ACCESS

MATERIAL TRANSPORT TO MICROWAVE OVEN LAMP ASSEMBLY

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ABSTRACT

The purpose of this work is to develop an Automated Guided Vehicle (AGV) for the transport of microwave oven bulbs for white-line companies. In order to do so, it is proposed to project and implement a mobile reactive robot that transports light bulb boxes with of defined weights, this robot being a line follower with built in sensors to move, making use of the computational tool Autodesk Inventor for drawing and mechanical tests and the development of the software in a language based on C/C ++, called Wiring. The assembly of the robot began with the creation of the mechanical design with the intention of assisting in the management and supply of the white lines providing a simple and fluid management delivering the bulbs on the depot path to the production lines not requiring the employee to leave the working environment. avoiding losses such as time and work accident while loading the product. The results obtained in the experiments performed during the research showed that the system performed the movement in a stable and correct way, that is, following the line until finding the requested position.

Keywords: Automation. Transport. Vehicle.

I. INTRODUTION

The standalone mobile robot has a line of applications for the future, even today with its focus on performing everyday tasks indoors. In some of these applications, platforms must be able to navigate and avoid obstacles. Regarding the line following robots, it can be inferred that a robotic system requires a map, where it should add the line in the real environment, then define its trajectory and then perform navigation [1]. Based on these applications, the idea of the reactive robot is to be a machine that needs human drives to do any preprogrammed action, being composed of peripheral devices that receive them and transfer them to the machine to perform accordingly. Thus, their actions need humans to be executed. This project aims to design a reactive mobile robot that transports microwave oven lamp boxes, being a line follower composed of sensors for locomotion, having devices for human activation, developed using an Autodesk Inventor design and simulation platform. ® and software development in a C / C ++ -based language, called Wiring, utilizing technical safety standards in every mechanical design, moving robot techniques, and human drive. Currently in the production lines of companies in the "White Line" segment of the Manaus Industrial Pole, they carry out the lamp feeding process manually, with one operator pulling parts in boxes, and taking to the line supplying their need for parts. that the process leaves room for loss of production efficiency, part deviation and mishandling of transported material.

Thus, an opportunity for improvement is needed, and it is possible to develop and implement a mobile robot that carries parts containing a human push button, and can be guided by a line sensor for path identification, monitored by software. supervisory, with a set of impact safety devices, all controlled by a microcontroller. As all automation requires structural adjustment by the company to be applied, however, any change becomes subjective since the layout of the feeder industry interface and production lines are different from company to company, as well as the layout Automation by companies is also different depending on the view of top management. Considering also that every change generates resistance, this same resistance becomes greater and evident when it comes to something that not all companies are used to, and this work tends to overcome this resistance.

II. LITERATURE REVISION

Robotics have the ability to act in various fields ranging from industrial use with AGV's and handlers to robots used in surgical medicine. It is treated as a set of applied theories, comprising various branches of engineering, such as mechanical, electrical and electronic, computing and cognitive sciences, such as biology. However, robots alone constitute only part of a robotic system [2].

According to [2], there is a relationship between the state of the industry with technological advancement imputed to robotics. The revolution in numerical and computational control and command of machines, the development of human-machine interfaces are factors that evidenced the need for automatic devices to perform activities.

The mobile robot has great difficulties operating in large unstructured environments and may have significant uncertainties in the position and identification of objects. Moving from point A to point B has an uncertainty along this path, which is a risky operation for a mobile robot. Operations have different indices that are measured by the uncertainty and precision required of the mobile robot, with priority being given to sensing and reasoning areas for it [3].

Since the model suitable for an application is more complex the greater the irregularities and uncertainties about the physical environment in which the robot will be inserted, as well as the higher the level of precision required. Thus, the controllers found in the literature are divided into three approaches: kinematic model, dynamic model or union of the two models [4].

The kinematic model treats robot movement as a function of its speed, while the dynamic model takes into account the motor torque and other forces involved in the system [5].

An Automated Guided Vehicle (AGV) is a mobile robot containing a series of sensors and communication circuits that make it autonomous, i.e. independent of humans.

AGV-based systems can be used for a variety of purposes, whether performing industrial or domestic tasks. These systems are most commonly used in warehouses and industrial plants, but can be found in cargo transportation systems, such as ports, or even in personal transport [6].

[7] says that with larger and more complex projects led to the search for tools that could help in planning, decision making and control of different activities. Changes in this environment began to take place during World War II with the creation, by the US Department of Defense (DoD), of a group of scholars analyzing the diversity between production line management and exclusive unemployment management. Efforts like these show the importance in particular approaches to project management.

Unique characteristics of the projects cause uncertainties regarding their results. [8] highlights the relevance of complex and uncertain factors in project production, [9] highlights that projects operate in almost all areas of knowledge. Thus, the activities to be performed require planning and engagement from all organizational parts, as the project may involve different professionals, units or organizations. At the beginning of the project, uncertainties, largely due to the influence of stakeholders on changing end products, are of a high degree, but they tend to decrease during development as knowledge increases and also because the cost to implement changes.

Project management is recognized as employing the knowledge, skills, tools and techniques to plan, schedule, execute and control project activities. It occurs by the proper application and integration of processes and their logical groupings. This makes it possible to achieve the objectives of a project. The most important objectives to be achieved include performance, cost and duration goals, while controlling or ensuring the scope of the project [10].

For [11], projects are characterized as an initiative with identifiable objectives, which consume resources and act under time, cost and quality pressures. Also, according to this author, the projects are increasing in size and complexity being perceived as a multifunctional activity. As a result, the challenge is not simply management of recursive activities based on standards of other projects, but mainly of managing activities that have not yet been performed and that may not be repeated in other projects.

III. MATERIALS AND METHODS

III.1 ELECTRONIC PROJECT

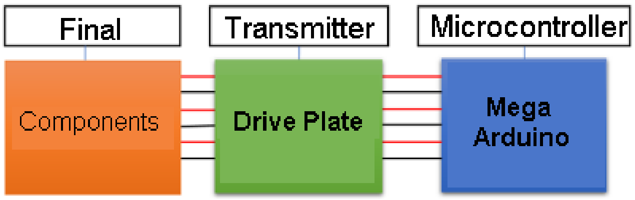

Figure 1: Control system.
Source: Authors, (2019).

Control System: The robot control architecture is presented in Figure 1, consisting of a microcontroller and its cable connection board.

Figure 2: Mega Arduino.
Source: Authors, (2019).

Arduino Mega: The microcontroller used to process and control the entire Robot is Arduino Mega for its simple C / C ++ programming mode.

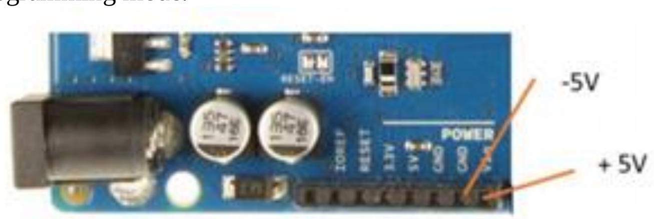

Figure 3: Power connectors.
Source: Authors, (2019).

In the robot it is necessary to have an autonomous power supply, not needing external sources to perform its functions. With that we have to power the Arduino through its power connectors, illustrated in Figure 3.

Figure 4: Control doors.
Source: Authors, (2019).

The microcontroller uses PWM ports to drive motors, which are ports to control the active cycle of a signal in order to control power. Basically, we will have a digital signal that oscillates between 0V and 5V with certain frequency. Figure 4 shows the Arduino Mega PWM ports and the motor driver, left motor on pin 3, and right motor on pin 2 connections.

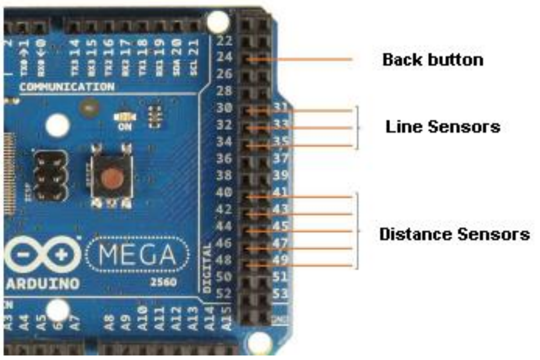

Figure 5: Digital ports.
Source: Authors, (2019).

The other devices are connected to the digital and analog ports, connected to the Arduino Mega digital ports, ten devices in all, as shown in Figure 5.

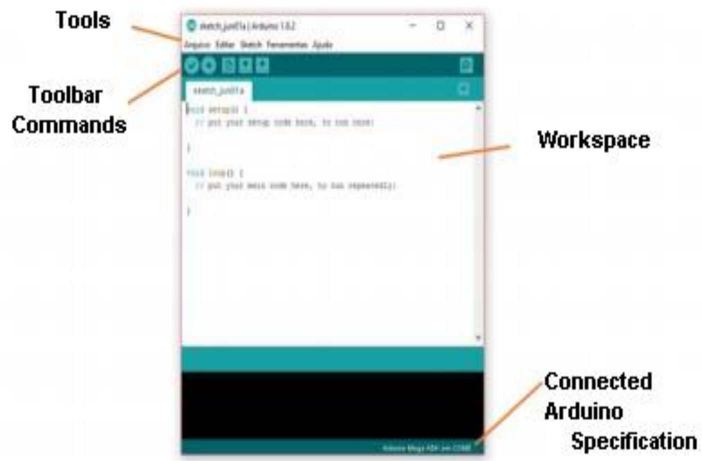

Figure 6: Programming.
Source: Authors, (2019).

Arduino itself has software where the programming will be done, illustrated in figure 6.

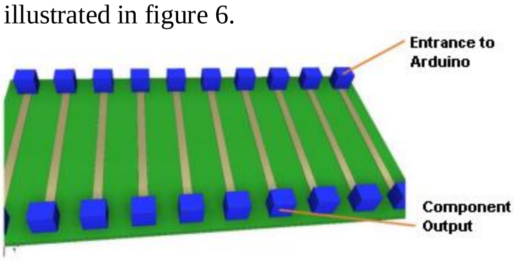

Figure 7: Drive plate.
Source: Authors, (2019).

Drive Board: The drive board of the devices is required to have the organized branching of the cables, being a transmission for all devices, consisting of:

- Two DC Motor Drivers;
- Three distance sensors;
- Three Line sensors; Being eight devices connected by this board, illustrated in Figure 7. Using this board as a connection broker, containing sockets that aims to prevent short circuits and mismatch between the Arduino and the device. So, this "cable" board leaves the microcontroller at the terminals, and the components at the serial terminals.

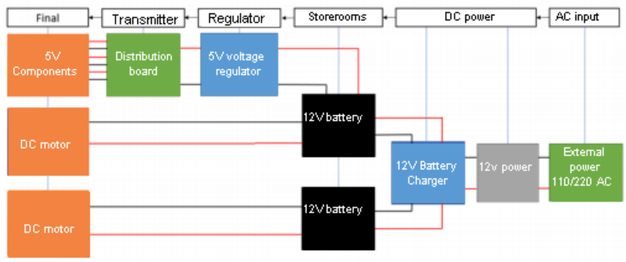

Figure 8: Electronic architecture.
Source: Authors, (2019).

Electronic architecture of the Robot as illustrated in figure 8.

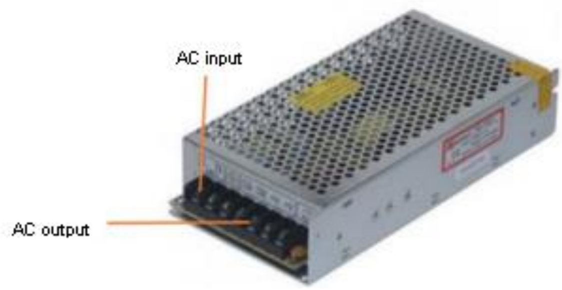

Figure 9: Battery source.
Source: Authors, (2019).

Battery Charging System: Using a Sready Power source, 100W power, 12 volts output, supporting 8.5A at full capacity, illustrated in Figure 9.

Figure 10: Strain gauge.
Source: Authors, (2019).

Charging the batteries requires a device that also measures and controls their charging. Controlled Module 12-24V battery charge control protection switch was used. This module has an input voltage of 10-30 VDC, and it is possible to choose the final voltage to be charged, with control knobs so you can choose this output voltage, illustrated in Figure 10.

Figure 11: Battery.
Source: Authors, (2019).

There is a need to add the input voltage from the external source by pressing the Start button for this function. After that, the Stop button is pressed to set the desired Battery charge voltage. To "reset" the settings, press the two buttons together to return to the factory setting using a 12v battery using the sealed battery model shown in figure 11.

Figure 12: Regulator.
Source: Authors, (2019).

The batteries are connected separately so that one powers the motors and the other powers the other devices. But to be charged, it has the connection together being placed in parallel in order to facilitate simultaneous charging.

5v Regulator: The voltage regulator has a potentiometer that regulates the voltage and shows on the display which voltage is helping to adjust the voltage through the potentiometer. The input of this module is connected to 12V battery, but is set to 5V which is the voltage of the components and the microcontroller, illustrated in figure 12.

Power board: The device power board is to ensure the organized branching of the cables, where there is a 5V voltage distribution for all devices, which are:

• One Mega Arduino;
• Six distance sensors;
• Three line sensors; Being ten devices powered by this board.

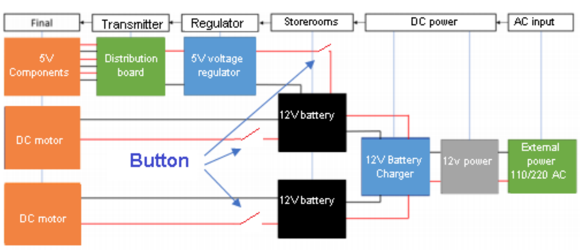

Figure 13: Electronic operation.
Source: Authors, (2019).

Electric operation: Containing two main systems in operation, one for charging the batteries and one for autonomous operation of the robot and in figure 13 we have the battery charging system, and we will have buttons to disable all devices of the batteries, with this we can charge the batteries safely.

Figure 14: Optical sensor.
Source: Authors, (2019).

Sensors: The line sensor of choice was the TCRT500 Optical Sensor Module, which operates in an infrared frequency range consisting of two LEDs, an emitter and an infrared receiver, illustrated in Figure 14.

Figure 15: Distance sensor.
Source: Authors, (2019).

Distance Sensor: HC-SR04 Ultrasonic Sensor, illustrated in Figure 15, capable of measuring distances from 2cm to 4m with great accuracy, six (6) of the same model around the robot were used for safety.

III.2 ACTUATION SYSTEM

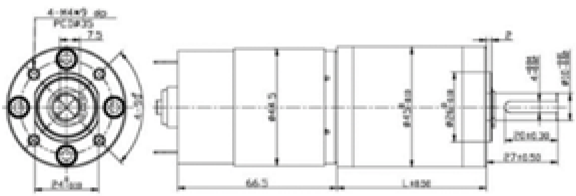

Figure 16: 2D engine.
Source: Authors, (2019).

Figure 17: 3D engine.
Source: Authors, (2019).

DC Motor: Gear Motor PG45775, illustrated in 2D in Figure 16 and Figure 17 in 3D, 12V power supply, 500 revolutions per minute, having a reducer coupled to its mechanism to increase its torque and 32kg / cm maximum power.

Figure 18: Motor Drive.
Source: Authors, (2019).

DC Motor Drive: Pololu High Power, Looking at Figure 18, adds the battery power to the driver's 12V input terminal, along with the cooler power. Connecting the motor to the 12V output terminal of the driver, containing inputs that establish the microcontroller PWM connections, causing this driver to have the functionality LED, which when connected is lit permanently, if it is in operation, the LED starts flashing continuously. the pulses generated from the control.

IV. STUDY APPLICATION

IV.1 MECHANICAL DESIGN ASSEMBLY

Figure 19: Wheel.
Source: Authors, (2019).

Wheels: The wheels should have as much friction as possible with the ground, so the fixed wheels with tire (tire) were chosen as illustrated in Figure 19 with pressure of 36 PSI, diameter 150 mm and load up to 80kg.

Figure 20: Silly wheel.
Source: Authors, (2019).

The choice of the dumb wheel is due to not having friction with the ground but resistance to the load applied on it, so as to have a structure that allocates weight on it, with allocation of weight not centered on the structure, for its stability and By the allocation of the wheels, in Figure 20 the illustrative 3D drawing, we have the chosen industrial caster which is made of polypropylene plate, supporting up to 90kg with 100 mm height.

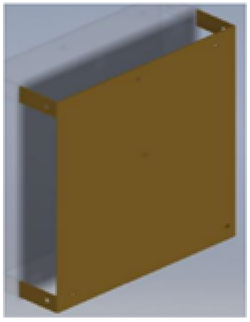

Figure 21: Robot Structure.
Source: Authors, (2019).

Robot Structures: Defining the size of the robot base by designing it in the Autodesk Inventor program, making it easy to add calculations to your measurements, as illustrated in Figure 21.

Figure 22: Aluminum sheet.
Source: Authors, (2019).

Using a mechanically deformed Aluminum plate 331, which is the bending of it by hardening, for one side of this plate to be coupled to the motor and the other upper one to be fixed to the plate. Figure 22 illustrates that the shaft passes through the plate.

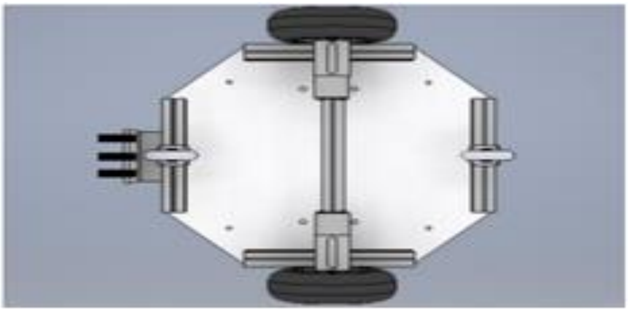

Figure 23: Base.
Source: Authors, (2019).

Figure 24: Base with batteries.
Source: Authors, (2019).

The mechanical base was structured with the wheels and motors, but the mounting of the support profile, allocated in a projected way. Figure 23 shows the assembled base. After the mechanical base, the components in the base, such as batteries and motor drivers, were allocated, illustrated in Figure 24, applying the weight of the batteries to the silly wheel, and installing the drivers next to the motors.

Figure 25: Base with the components.
Source: Authors, (2019).

Soon after the base with components, the support structure of the electronic panel was added. Placing a Bosch profile 40x40 mm perpendicular to the base, 640mm long, used as a column, supporting the board with all components. As illustrated in Figure 25, finally, the sensing structures, consisting of the line sensor and distance sensor, were added.

IV.2 ARDUINO ROBOT CONTROL ALGORITHM

Figure 26: Programming Platform.
Source: Authors, (2019).

The software used for programming is from the Arduino microcontroller company itself, illustrated in figure 2, just go to the company's website <https://www.arduino.cc/> and download the platform using the C language / C ++ will be able to apply it so that the robot works autonomously, sending the programming directly to the mega Arduino that is allocated in the robot.

V. RESULTS AND DISCUSSIONS

The line follower has a simple but important behavior that allows the use of mobile robots in structured environments such as industry. By going through pre-established paths, marked on the floor by a line, making several practical processes to be automated.

Figure 27: Demarcation for the robot to follow.
Source: Authors, (2019).

The first test of the line follower, has the construction of the circuit in the ground, with curves at an angle of 20 degrees according to the track, illustrated in figure 27. The implemented project had as improvement the supply performance of the white line. From microwave oven making management easier for the employee and line manager, team was meticulously deity in field testing and data collection for possible improvement if the project generates interest in some manufacturing institution.

VI. CONCLUSION

This work aims to develop an Automated Guided Vehicle (AVG) to transport microwave lamps from white line companies. Thus, it was proposed to build an electromechanical structure that moves and maintains safety for the people around. The results obtained in the experiments carried out during the research, with varied locations and trajectories, showed that the proposed methodology is effective, but it has not been applied yet in the white line companies due to the property security policies as well as the unwillingness on the part of the companies to do so. Invest time to conduct tests on either normal production or production simulations on microwave oven lines or even making adjustments to the physical structure of the unit to be implemented. It is also noteworthy that the implementation of this work intends precisely what is the essence of Control and Automation Engineering: the control and automation of processes; processes whose merits exemplify eliminating the need for wage and overtime payments, hazardous and unhealthy, monthly and extra benefits, excluding the risks of accidents occurring without and with leaves, unsafe conditions or behavior, economic risks associated with the process applied besides offering the possibility of working in different conditions.

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