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AUTOMATIC LAWN MOWER WITH OBSTACLE DETECTION AND AVOIDANCE

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Abstract: There isn't enough time for our daily activities in the fast-paced world of today. Everyone struggles to maintain their mental stability while carrying out daily obligations. Robots have been developed to make human labour easier, and we have similarly offered the idea of a "Automatic Lawn Mower with Obstacle Detection and Avoidance" Robot. Without any assistance from humans, our robot maintains the beautiful, green lawns by evenly cutting them. The sensors built into an autonomous lawn mower robot operate as the robot's eyes and guide it. The system is stable and application-specific due to the microcontroller-based programmed operation. A lawn mower is a tool used to trim the grass on a lawn. The lawn mower's blades are typically propelled ahead by pushing the machine forward. Several factors are used to categorize lawn mowers. For instance, reel lawn mowers, which have a horizontal axis of rotation, and rotary lawn mowers, which have a vertical axis of rotation. There is a reel (cylindrical) lawn mower. It is discovered that the reel (cylindrical) lawn mower is superior. They are made of blades on a rotating cylinder ground that the revolving mower blades come into contact with as it advances. The mower may be set to different cutting heights. Rarely is the blade sharp enough to provide a clean cut. The grass is simply chopped by the blade and brown tips are the outcome. Nonetheless, it is simple to remove, sharpen, or replace the horizontal blades. Again depending on the energy source, we may have a hand-powered, gasoline-powered, or electric lawn mower. To put it simply, robotics is nothing more than managing the group of motors put together to carry out the predetermined tasks. This system is controlled by physical sensor inputs, and the microcontroller unit, which is always the brain of any kind of automation, establishes the required output depending on the inputs collected by the sensors.

Keywords: Lawn mower, Microcontroller, Robot, Ultrasonic sensor.

I. INTRODUCTION

An autonomous robot is employed as a robotic lawn mower to trim grass. The usual robotic lawn mower (especially older generation versions) needs a border wire placed up around the grass to identify the area to be mowed. This cable is used by the robot to determine the area's perimeter and, in some situations, the location of a dock for charging. Up to 30,000 m2 (320,000 sq ft) of grass can be maintained using robotic mowers. Around 1830, English engineer Edwin Beard Budding was working in a textile mill when he noticed that a tool used to cut carpet textiles could be copied and altered to create a machine that could cut grass. Budding designed a cutting cylinder positioned on a bench with a self-propelling mechanism, inverting the original system as his model. The world's first lawn mower was created as a result. The earliest lawnmower featured cast iron gear wheels, a large roller up front that housed the cutting cylinder, and a wooden handle.

The wheels of the first mower transferred power from the back roller to the cutting blade, similar to the design of today's self-propelled lawn mowers. A lawn mower is a tool used to trim the grass on a lawn. The lawn mower's blades are typically propelled ahead by pushing the machine forward. Several factors are used to categorize lawn mowers. For instance, reel lawn mowers, which have a horizontal axis of rotation, and rotary lawn mowers, which have a vertical axis of rotation. There is a reel (cylindrical) lawnmower. It is discovered that the reel (cylindrical) lawn mower is superior. They are made of blades on a rotating cylinder, and their scissors like motion produces crisp cuts. The bed knife is a fixed bar that is parallel to the ground that the revolving mower blades come into contact with as it advances. The mower may be set to different cutting heights. Rotary mowers are typically operated manually, with the engine just spinning the cutting blades, and are frequently powered by internal combustion engines or electric motors. In general, rotary mowers have an opening on the side of the housing through which the grass clippings are discharged .Some have a grass collector attached at the outflow location. Rarely is the blade sharp enough to provide a clean cut. The grass is simply chopped by the blade and brown tips are the outcome.

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Nonetheless, it is simple to remove, sharpen, or replace the horizontal blades .Due to the development of the zero-turn mower and hydraulics, there were a great number of lawn mower manufacturers in the 1980s. Several lawn mower models were created by various firms. This created a strong competition that only pushed each participant to raise their level of play.

Manufacturers of zero-turn lawn mowers are constantly improving the model. Better cutting capabilities and a more compact appearance are among the factors they consider. Zero-turn lawn mower producers are continually refining the design. They take into account things like improved cutting skills and a more compact appearance. And then the lawn mapping is introduced, which uses a systematic approach rather than cutting in a random pattern, was developed by the Bosch Indego in 2012. In 2019 saw the announcement of vision-based robotic mowers without boundary fencing. The mower can find its charging station via radio frequency emissions, by following a boundary wire, or by following an optional guide wire. Lawn mowers come in a variety of styles, dimensions, features, and specs nowadays .Future inventions including computerized mowers, remote-controlled models, solar powered devices, robot mowers, and even devices that employ laser beams to cut grass are anticipated by industry players. They might not be economical, thus there is a greater demand for useful yet straightforward ones. Computer-based ground level control is not feasible. This unique technology might be effective, but it might come at a high cost that contractors can't afford . The best slope mowers for safe and effective lawn maintenance on difficult terrain are remote-controlled models. This kind of mowers can decrease a five man team to a two-man crew and are perfect for steep slopes like the ground in Hawaii. This makes maintenance possible while reducing on-site injuries.

II. PROPOSED SYSTEM

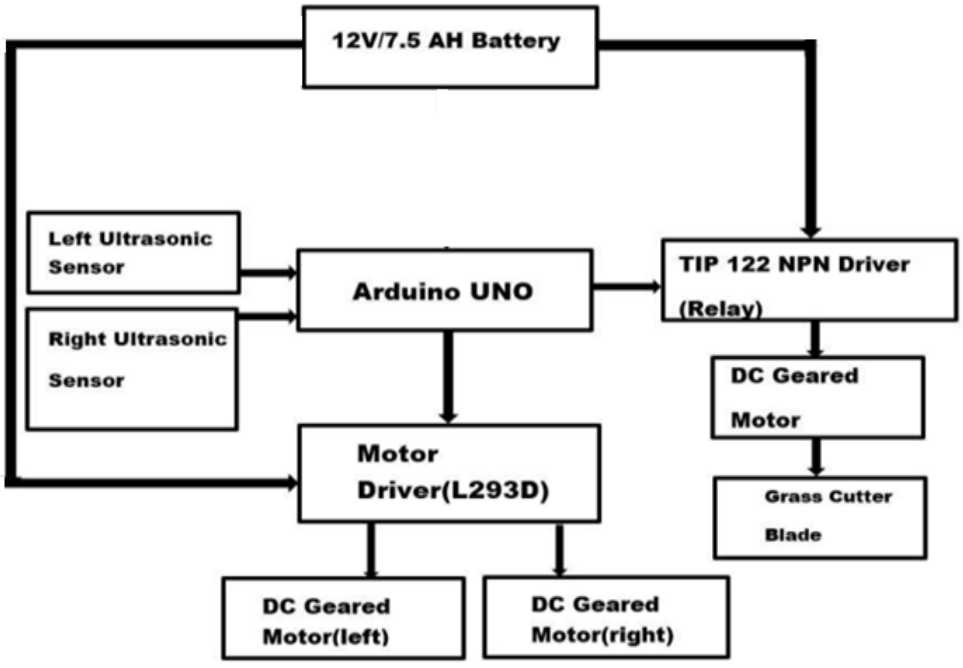

Fig. 1 Block diagram

The Fig. 1 represents the overall data flow of our project “AUTOMATIC LAWN MOWER WITH OBSTACLE DETECTION AND AVOIDANCE”. As shown in the above figure, the power supply of the entire robot is supplied by 12Volt Lithium Ion Battery of 7.5aH ampere rating. This battery is chosen for our project in order to give long lasting backup for our grass cutter robot and also this can be recharged with the help of external power supply when it is drained completely. The microcontroller used in our project is Arduino Uno microcontroller unit which has in built on board voltage regulator (7805) and hence the 12Volt power source directly from the lithium Ion battery is fed to Arduino Uno board for its operation. The Obstacle from the Left side and Right Side of the robot is determined by the Ultrasonic Sensors which is capable of detecting the obstacles even from the long range. It operates in the principle of ultrasonic sound waves which is emitted by the ultrasonic sensor transmitter and the reflected wave captured by the ultrasonic sensor receiver and hence the distance of the obstacle is measure by calculating the transmitted signal and received signal

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timings. The L293D motor driver is used in our project in order to control the movement of the robot in both the direction. The L293D motor driver is also known as H-Bridge motor driver used to control the direction of the geared DC motor used in our project. The Direction of the motor can be altered simply changing the signal polarity fed to the motor driver by the microcontroller unit. The grass cutter high speed motor is controlled separately with the help of TIP122 5 Amps motor driver since it requires high torque while cutting the heavy bush like grasses present in the garden.

III. WORKING PRINCIPLE

Our thing is to design an automatic smart lawn mower to cut the field without any human interaction. It also detects the obstacles to guard the human/ object from any damages that come along their path and was successfully designed and enforced.

On hindrance spotting the ultrasonic detector monitors it and the microcontroller will stop the lawn cutter motor to avoid any damage to the object/ human/ beast whatever it is. The microcontroller also turns the robot as long as it gets clear of the object and also moves the lawn knife in forward direction again.

From the flowchart in Fig. 2, d1 is the distance between the left wheel and the hindrance, d2 is the distance between the right wheel and the hindrance.

• If d1 is lesser than 15 and d2 is lesser than 15, then there's no hindrance. So the field mower will move in forward direction.

• If d1 is lower than 15 cadence, then the hindrance is detected in left wing. So the field mower will move right and the continue in the forward movement.

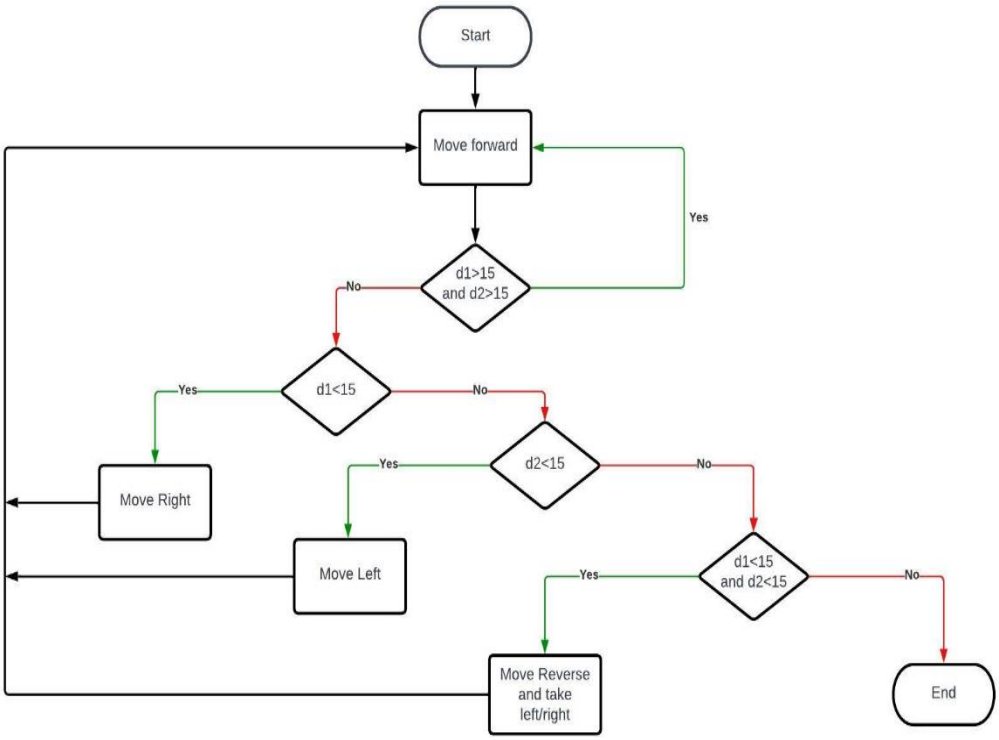

Fig. 2 Flowchart

• If d2 is lower than 15 cadence, then the hindrance is detected in right. So the field mower will move left and the continue in the forward movement.

• If d1 is lower than 15 and d2 is lower than 15, then the hindrance is detected in front. So the field mower will move in backward and move out from the hindrance, then move in forward direction.

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IV. HARDWARE IMPLEMENTATION RESULTS

The Fig. 3 represents the overall hardware implementation model of our project "AUTOMATIC LAWN MOWER WITH OBSTACLE DETECTION AND AVOIDANCE". With the below table, the overall operation of the robot is explained briefly.

Hardware development is concerned with the mechanical and electronic components that are assembled to form a project component, in this case an autonomous lawnmower robot. Both aspects must function properly because they must work in tandem to complete a task.

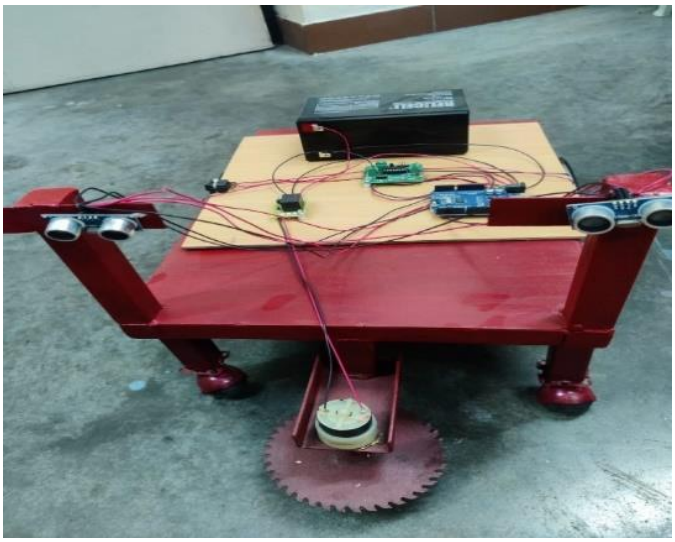

Figure 3. Mechanical design of autonomous lawn mower (front)

The lawn mower has two wheels attached to the back. The two wheels at the back of the self-driving lawn mower are powered by DC motors. Both DC motors controlled the movement, whether it was forward, backward, left, or right.

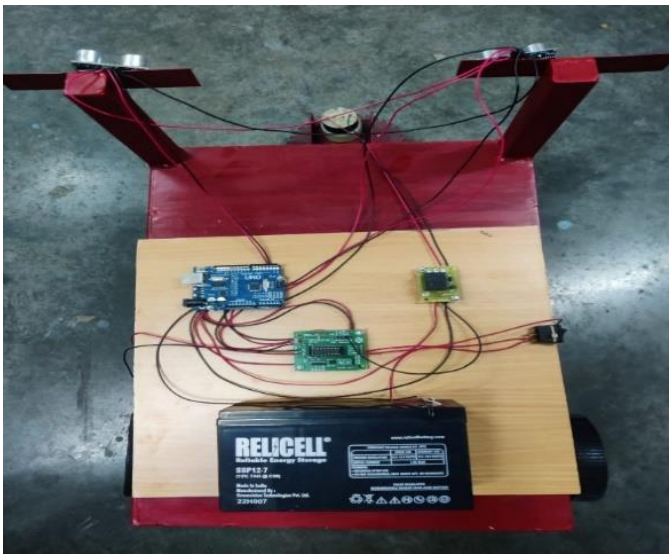

Figure 4. Upward view of the lawn mower

The mechanical design of an autonomous lawn mower is depicted in Figure 4. (front).It depicts an upward perspective and the top view of the lawnmower .Also This diagram depicts the connection between the mechanical components and the control system.

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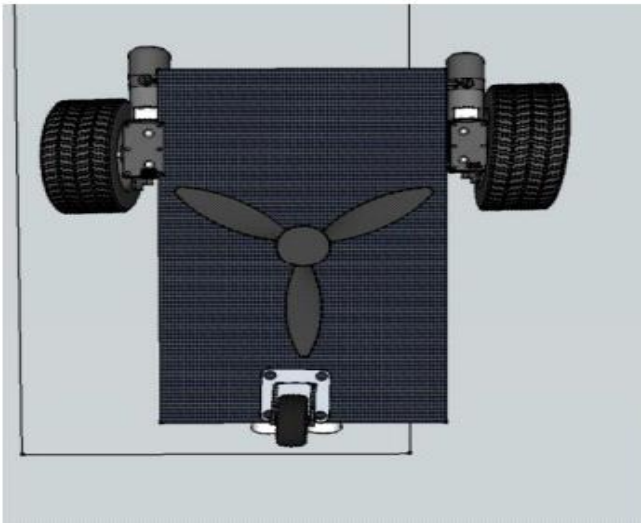

Figure 5. Bottom view of the lawn mower

Fig. 5 depicts the bottom view of the lawnmower .A small wheel is also being added to the front of the lawn mower's outer body. This allows the lawn mower to move more easily. And the board is attached to the lawn mower's upper side. Board serves as the lawn mower's brain, controlling all of the hardware. While the robot is in operation, the FPGA board controls the signal to each piece of hardware. The blade for cutting is located at the bottom of the body. This blade is powered by a DC motor and spins to cut the grass. In order to ensure that the spinning blade cuts the grass perfectly, some measurements must be taken.

Figure 6. Side view of lawn mower

The Fig. 6 depicts the connection between the mechanical components and the control system. The FPGA was connected to both DC motors. Both motors' speeds will be controlled by the FPGA. A model of the autonomous lawnmower is sketched using a decision making algorithm in order to create a prototype.

Any adjustment can be made, whether at the front, back, upper site, or under the robot's body. As a result, it is simple to determine whether or not there is any miss aligned or unconnected area. It is also simple to construct a real model of an autonomous lawn mower using this method. The table I shows the sensor detection of the obstacle and the corresponding robot movement.

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Table I Sensor detection and corresponding robot movement

S. No	Left Obstacle Sensor	Right Obstacle Sensor	Robot Movement
1	Not Detected	Not Detected	Forward
2	Detected	Not Detected	Right
3	Not Detected	Detected	Left
4	Detected	Detected	Reverse

V. CONCLUSION

Thus with the help of our project we can easily maintain our lush green garden with the help of our Autonomous Grass cutter Robot without any human intervention and hence we can save more time and concentrate on our other works in this fast moving world. Also since the overall system is designed to be run in the battery resource instead of petrol or diesel, it also promotes eco friendly nature.

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