Intelligent Solar Powered Grass Cutting Robot with Obstacle Avoidance

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Abstract: One of the major problems associated with grass lawn is to maintain proper height of grass. Traditional methods available are based on manual grass cutting or manually operated lawn mowers, both requires skilled labour. The problem becomes very cumbersome, when area to be covered is very large. Many researchers have come up with the solution of automatic lawn mower. However, major issues with such machines are length of perimeter guide wire, high price tag & maintenance cost. If battery operated, then longevity of the battery. In this paper, an intelligent solar powered grass cutting robot with obstacle avoidance is presented. The system is consisting of ARM 7 controller to which colour and ultrasonic sensors are interfaced. The system was tested on different conditions and it is observed that, it can be used efficiently on flat lawn surface.

Keywords: ARM 7 controller, colour sensor, ultrasonic sensor, h-bridge.

I. INTRODUCTION

Modern gardens are incomplete without grass lawn. Grass lawn adds architectural feature and beauty to gardens, playgrounds, hotels, home, factories etc. Depending on how it is planted, lawn is also known as turf, pitch or field. In India, different types of grass [5] are used in lawn viz St. Augustine grass, Chain grass, Kikuyu grass etc. The most common grass type used is ‘Cynodon dactylon’ also known as ‘doob’ grass. It grows 4 cm in height after 4-5 weeks of after seeds are sowed and requires cutting after 8-12 weeks.

To maintain its proper height, periodic cutting of grass is required, which is done either manually or by using machine also known as ‘lawn mower’. Manual cutting requires skilled labor and the work must be done under supervision. To operate lawn mower skilled labor is required as well as it requires periodic maintenance.

Earlier solutions include use of microcontroller-based systems to which various sensors are interfaced [1]. These are manually controlled and are having slow response time. Some lawn mowers were implemented by using of Internal Combustion Engine [2]. The major drawback of this technology is high running cost, noise and air pollution.

In this paper, an automatic lawn mower which operates on solar energy is discussed. To improve response time, ARM 7 (LPC2148), controller is used, which is relatively faster than other microcontrollers. Figure 1 shows block diagram of the developed system. The color sensor module and ultrasonic sensors are connected to port 0 & 1 of ARM controller.

![Figure 1. Block diagram of the system](image-url)

Mobility to the system is provided by 4 bidirectional dc motors controlled by H-bridge. A grass cutter connected to variable speed dc motor is interfaced to port 1 of controller. The height of the cutter can be adjusted manually by using IR sensor. Based on the data processed, the system moves in predefined direction. To provide flexibility of operation the system can be also operated manually.
II. WORKING

The color sensor (12F675) detects primary colors by switching them one by one and generates intensity values for each color from the reflecting surface. The reflected intensity is converted into 8-bit value for each color Red, Green and Blue, and is transmitted serially at baud rate of 9600bps with frame size of 25 bytes for each 500ms interval. When the sensor detects Green color, it generates values ranging from 1-255. From experimentation, it has been found that, when the sensor generates value greater than 50, grass is suitable for cutting. The color value is compared with the reference value stored in the memory of ARM controller. If the value is greater than reference level, then binary 1 is transmitted to pin 7 of port 1 of ARM7 controller and the dc motor to which cutter is connected gets turned “ON”.

When the system reaches boundary of lawn, color sensor sends value below the reference level. The ARM controller sends binary 0 to pin 7 of port 1 which turns ‘OFF’ the cutter. Now the 4-dc motors connected to H-bridge are turned ‘ON’ and the system makes 180° U-turn. During grass cutting operation, there is possibility of getting obstacle in the path of system. An ultrasonic sensor HC-SR04 connected to port 0 continuously transmits ultrasonic sound in forward direction. It compares time delay between transmitted and reflected sound. When obstacle is present, time delay becomes very small. The system will change its path by moving 90° left and once again follows the straight path. Fig. 2 and Fig. 3 shows snapshot of the system.

III. OBSERVATIONS

The system has been tested under different conditions viz. lawn on flat surface, uneven lawn surface and patchy lawn.

Condition 1: - When the system is kept on flat surface with grass, color sensor transmits no value corresponding to green color and the system remains in stationary state.

Condition 2: - When the system is tested on flat surface and uneven lawn surface, color sensor transmits value corresponding to green color to the ARM controller. If value is matched, grass cutter starts cutting the grass. For both cases, system operates normally. However, in case of uneven grass surface, when the system is descending from top, obstacle detection stage fails to detect object present very close to it.

Condition 3: - In case of patchy lawn surface, it has been observed that, the system halts its operation whenever no grass is present and must be operated manually using remote control.

IV. CONCLUSION

In this paper an ecofriendly solution for lawn mowing is provided. From observations, it may be concluded that, the system is more efficient considered to earlier designs, as it eliminates need of man power as well as it is pollution free. The system works very well on flat surface lawn, however in case of uneven surface; obstacle detection stage fails to detect objects near to the system. Also, for patchy lawn surface, the system halts when no grass is detected and requires manual control. To improve performance, future work must focus on development of more robust solutions for above mentioned conditions for which image processing can be possible solution.

REFERENCES

AUTHOR’S BIOGRAPHIES

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