

## Smart floor cleaning bot

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*Abstract - With the advancement of technology, the researchers are working in this domain at a faster pace to eliminate various tire some tasks of mankind to make life simpler. In the era of smart home systems, among all kinds of household devices, autonomous cost effective cleaning robots with better navigation facility have become a necessity. We are designing and fabricating a prototype - "smart floor cleaning bot". It is a compact robotic system which eliminates time and energy consuming mopping process in big rooms, homes, offices and industries. The main aim is to make a cost effective and convenient device for the common man in such a way that it can be used daily. This bot will use its intelligence to detect obstacles on its own and avoid them and clean the surface. The bot will be programmed with algorithms which will enable it to decide and choose the most optimum path for cleaning the area. The bot will have 2 modes i.e autonomous mode where only ultrasonic sensors work to avoid obstacles and change the direction of bot and the manual control mode wherein the bot is controlled through an application which will help the user to clean certain areas according to user satisfaction.*

**Key Words - Smart, Autonomus, Manual, Bot, Obstacles, Algorithms, Cleaning.**

### 1 INTRODUCTION

Home automation delivers convenience and saves a lot of time. "Smart floor cleaning bot" will automate the entire mopping process along with the manual mode. It will cover the maximum floor area to be cleaned in the least possible use of water. Also, it will be completely wireless. It aims to reduce the time, effort and manpower needed for mopping the floor. This way people can spend their time in other fruitful activities every day and direct their energy to do something productive. Also people can clean the floor using manual controls provided, by being seated at one position itself and clean the entire area to be mopped if needed.

### 1.1 Motivation

Every day many men and women spend their time for cleaning the floor of their homes. This task can be done by the automated mode. And also provide manual control for user satisfaction. The bot is to be cost effective. The target audience is the common man who can afford it for daily use. It is a routine house-chore of the women for mopping the floors or their dependency on maids to do the task. To reduce this effort and dependency on others, this project idea was proposed. To save time and efforts along with wastage of water put in this tedious work, the idea of bot was suggested.

### 1.2 Background

Today mopping process takes a lot of time and effort and is a very tedious process. A lot of water is consumed for the task. Approximately 2-3 LPCD (liters per capita per day) of water is used by an Indian which actually costs to 60-90 LPCD per month on an average for mopping process. A lot of manpower is also invested for this process. Women are dependent on maids to do this work. Many organizations, especially in developed nations have come up with devices which can clean the floor efficiently. But the main drawback is that they are very expensive which the common man cannot afford. Though there are cheap devices available in the market, they would be manually controlled or if automated and cheap, it would not give us precise output. To develop an autonomous, cost effective design giving precise output and using minimal amount of water is proposed.

## 2 LITERATURE SURVEY

For automated cleaning, IR sensors along with ultrasonic sensor can be used for obstacle detection and avoidance for mopping. But using only the sensors is a limitation as it doesn't justify the smartness.[1] the 3d camera can be used instead of the sensors to efficiently detect obstacles and use some particular algorithms to avoid them. This can be done by feeding data set of the objects present in a normal working environment of a bot.[2] It would also help the bot to calculate the distance of the obstacles present around it from its current position itself along with the dimensions of the obstacles. This would in turn help it to identify between the wall and the obstacle.[2] but the bot is to be cost effective, thus using 3d cameras would be very expensive. Two 2d cameras can be used to lower the cost of using one 3d camera to some extent by developing a stereoscopic vision by merging the inputs from the two 2d cameras, but that too would be complicated[3]. Using thermal cameras to give variable outputs with respect to the radiation being sensed from different materials and objects proved to be inefficient as it varies in accordance with the distance being sensed.[4] OpenCV is used for computer vision purpose which uses python.[5] Thus, a 2d camera along with ultrasonic sensor and IR sensors is merged to eliminate the limitations. OpenCV computer vision algorithm is used with the Raspbian OS which is greatly compatible with the Linux OS. But again although this methodology seemed theoretically possible, practically it was giving real time delay. The duty cycle of image processing by webcam and ultrasonic sensor response time were not matching due to which ultrasonic sensor gave garbage values which consequently resulted in crashing of bot directly to the wall. [6] Thus, finally we implemented 2 modes into bot i.e autonomous which will use ultrasonic sensor and follow the basic path avoiding obstacles and manual mode which has been implemented using an application wherein the user can have control over the motion of the bot and clean a particular area as per convenience and requirement.

## 3 METHODOLOGY

### 3.1 Block diagram

The following figure shows the basic block diagram of the design:

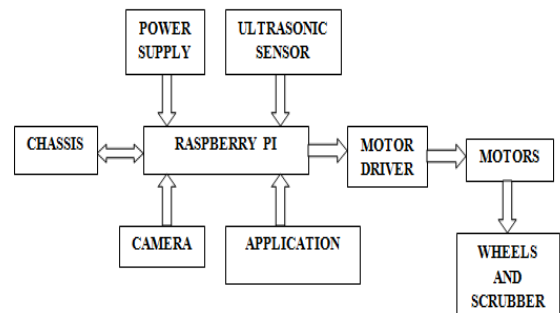


Fig. 1. Block diagram

The bot can be operated in two modes namely – Automatic and Manual. In the automatic mode, the bot follows a linear path and takes an U-turn when it encounters an obstacle. The obstacle is detected from the data provided by ultrasonic sensor. The algorithm is designed in such a way that it tries to cover maximum area of the floor while cleaning. In the manual mode, live streaming is provided in the app by the USB camera which is connected to the Raspberry Pi. This lets the user see what's in front of the bot and accordingly control the bot by the buttons provided in the app. The motor which has a scrubber attached to is kept on continuously along with the water being dripped on it by the water pump. This is the cleaning mechanism. The motor drivers have the driving circuitry required to control the motors with stability. Two motor drivers have been used, one for driving the 4 motors(60 rpm) connected to wheels and one for the motor (30 rpm) connected to the mop. The power bank provides power to Raspberry Pi and the motors are driven by a 12V Lead-Acid Battery.

## 4 SOFTWARE IMPLEMENTATION

### 4.1 Flowchart

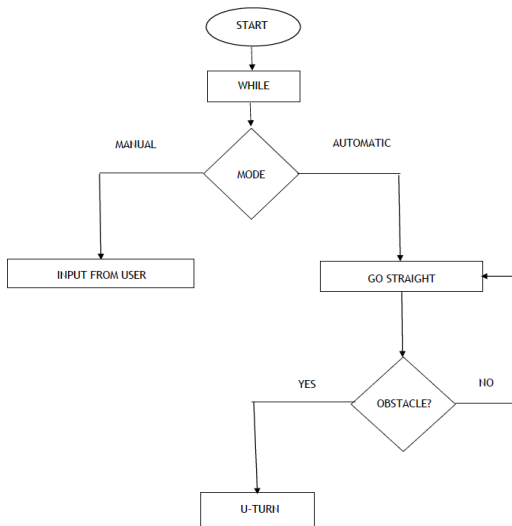


Fig. 2. Flowchart

When the bot is turned on it checks which mode is selected by the user. If it's the automatic mode then it starts moving straight and if it encounters an obstacle it takes a U turn and again goes straight. In case of manual mode, the bot directs itself according to the commands received from the user via the app.

## 5 ADVANTAGES AND APPLICATIONS

### 5.1 Advantages

- Coverage of maximum area of floor
- 2 modes of operation : Automatic and Manual
- Wireless
- Prevents water wastage

### 5.2 Applications

- Health & Hygiene: In hospitals, household applications, in industries where especially environment is toxic so manual cleaning is risky, in schools, large organizations and other domestic purposes.
- Agriculture: Crop, food and water It can be further used for transportation by implementing pick and place facility along with providing water as per the requirement.
- Domain: Embedded Systems and Artificial Intelligence

## 6 CONCLUSION

An autonomous and wireless bot which can mop the floor without any human intervention. A bot which covers maximum area while mopping due to the incorporated algorithm and provides efficient output covering every corner of the area to be mopped. The components and modules used will be such that they consume minimal power. All the components used will adhere to the function of mopping and will be as affordable as possible which can be used by common man as well. There will be minimal usage of water, so it's wastage would be avoided.

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