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Research paper

Autonomous movable packrat for habitual chores

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Abstract

Internet of Things (IoT) and artificial intelligence (AI) can play a major role in improvising the way we live. Improvement in quality of life can be achieved by connecting devices. Thus we present a waste collection solution based on providing intelligence to waste bins, using an IoT prototype with sensors. Here we provide with an autonomous intelligent system that moves automatically when it detects waste. We use kinetic sensor that identifies the trash and help the robot in picking it. It can read, collect, analyze the trash collected and report the user about the facts such as the time at which the more amount of waste get collected and the kind of waste which gets accumulated in large in number. Such data, when put into a spatio-temporal context and processed by intelligent and optimized algorithms, can be used to dynamically manage waste collection mechanisms. In addition to the above the unique characteristic of the robot is that it collects even the small dust particles through suction mechanism.

Keywords: *Internet of Things (LoT); Artificial Intelligence (AI); Kinetic Sensor.*

1. Introduction

In this competitive world it is important to be innovative, updated, productive and deviceful to compete with the developing technologies. The national academy of science, USA states "rising above the gathering storm" and its 2010 update called for significant investments in science, technology and education [1]. Automation is a part of today's life and it is inevitable. Automation is something in which gadgets work on its own without manual interruption. They help us to provide digital work force which are more flexible, scalable and are at unprecedented speed at ease. History is evidence to the fact that life got easier and more efficient with the invention of computers and the automatic opportunities it brought along. Macros are the starting point for automation where it can be saved and called with the key stroke. The major idea behind this is to speed up the task and free someone from performing repetitive task so that they can force on intelligent activity. Today automation has gone so far that a whole factory can function with bots that are programmed to perform those tasks without manual interruption and just with human supervision. A robot is simply a machine which is designed to accomplish a particular task. Hence this machine uses their programming to make decisions. We, the humans have expected or designed robot to perform the activities which are all possible by humans. This is not hundred percentages possible. But this had made possible to some extent. Most of the robots use sensors for input, control systems for decision making and end effectors for output. There are certain demands which these components should satisfy. This include that the sensor should be more accurate and sensitive in gathering data, effectors should be flexible and faster in what they do and the control system should make all of the necessary decisions to make the sensors and effectors work together. Robots came into use where it can replace the regular and repetitive work of humans.

In this project, an innovative, low cost robot is designed and developed to pick the trash in our residence. It acts as a wandering trash that detects the craps. The robot is built using commercial of-the-rack materials and components, free open source software and open source hardware. Robotics is one the ingenious technology of our time and has a notable bond to other growing technologies like autonomous machines, 3D- printing, cyber-physical systems, internet of things, renewable energy and so on [2]. It is aimed that the project will accord something to elevating environmental awareness, in helping clean up the environment. The robot is also provided with a mechanism to cleanse even the small dust particles that is left over after picking up the craps.

2. Existing system

A big social fettle dispute being faced in divers advancing countries, such as India, is absence of cleanliness and uncollected trash littering the streets, roads and sidewalks. May be, this seems to be a simple issue when it is considered for very small area. But considering a huge landmass, such as India with these uncollected trashes is really a major problem which needs more concentration to solve as soon as possible. Many have tried to change this state and many government plans have been announced as this is major issues which indulge every citizen. One such important plan is clean India. The ultimate goal of this plan is to make India clean by October 2, 2019.

Not humans alone can do this and it is not necessary that only humans alone should do it. Autonomous trash collection is not a new topic. The base of this is that an automated system is created to clean vast area. They are, in more generally tested in school premises. But keeping the local premises clean would do a greater deal.

Fig. 1: Existing System.

Based on this many automatic trash collecting robots have been developed. Some remarkable and game changers are one which includes path planning, navigation, object detection and discrimination, obstacle avoidance, task sequencing and, multi-agent coordination. Yang, et al have developed a robotic trash barrel, consisting of a commercial mobile robot (iRobot Roomba) with a trash can mounted on top [3]. Yang, et al have developed a robotic trash barrel, consisting of a commercial mobile robot (iRobot Roomba) with a trash can mounted on top [3]. They just tried to create a machine which does social interactions and are easy and friendly to use. Kulkarani and Junghare [4] have developed an autonomous wheeled vehicle with on-board manipulator for indoor trash detection and collection using ultrasonic sensors. An autonomous wheeled humanoid-type robot for home mess clean-up has been proposed by Ma, et al [5]. An indoor toy mobile robot for encouraging children to tidy up their toys has been proposed in [6]. Yamaji, et al have developed a mobile robot as a sociable Trash Box which interacts with children in the collection of trash [7].

All this research focused on a factor that robots should be made economical, available, bilateral, collective, communal, cultural, informational and inconclusively constructive robots for stationing and dissemination in advancing countries. Thus, they majorly focused on being philanthropic, in the sense that not all waste can be and should be cleaned by human itself. Where Wi-Fi access to the Internet is possible, for example in the vicinity of the school, children can even teleoperate the robot over the Web [8], [9].

The product of the existing system is designed as a not fully automated. It is provided with wheels in the bottom. Thus they can move around the premises, not automatically but with human intervention. Hence they are mobile. The body part of the robot is designed as hallow. This is because they are used as the place where the trash gets collected. These bots are provided with arms. As these kinds of bots are made with off-shelf components these arms are not made mechanically. These bots are designed to collect only the solid and trash which are visible to naked human eyes. Hence, they don't clean the minute dust particles which are found hard to get cleaned. These bots as they are not autonomous, don't detect objects on its path while moving.

3. Proposed system

In-spite of numerous robots available in market for trash collection there are still major disadvantages in all of them available. May be some of their issues cannot be solved, but most of them can be. Thus, the autonomous mobile packrat for residential chores helps us to overcome some of the issues which are found in others. In this project, an innovative, low cost robot is designed and developed to pick the trash in our residence. It acts as a wandering trash that detects the craps. The robot is built using commercial of-the-rack materials and components, free open source software and open source hardware. Robotics is one the ingenious technology of our time and has a notable bond to other growing technologies like autonomous machines, 3D- printing, cyber-physical systems, internet of things, renewable energy and so on[2] . it is aimed that the project will accord something to elevating environmental awareness, in helping clean up the environment. The robot is also provided with a mechanism to cleanse even the small dust particles that is left over after picking up the craps. The major idea behind this is to speed up the task and free someone from performing repetitive task so that they can force on intelligent activity. Today automation has gone so far that a whole factory can function with bots that are programmed to perform those tasks without manual interruption and just with human supervision. A robot is simply a machine which is designed to accomplish a particular task. Hence this machine uses their programming to make decisions.

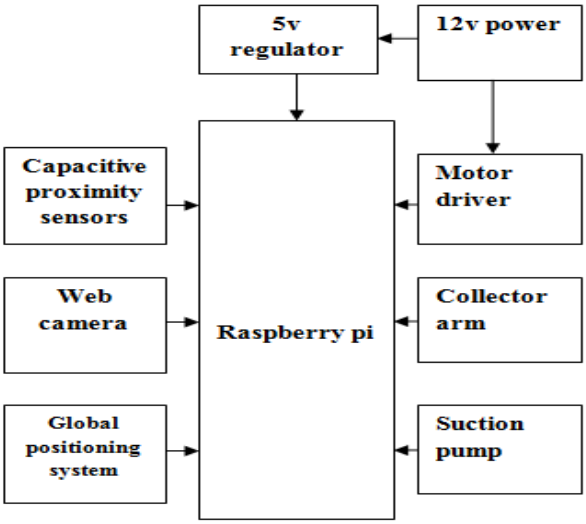

Fig. 2: System Architecture.

The first major issue with all of them is that they are not completely autonomous. That is they cannot move around freely on the premises where the trashes are scattered. They need human intervention to control their movements. Thus, in our system we have made the robots a complete autonomous. That is, they can move around the premises on its own. This can be achieved by using image processing as a major technology. That is the robot regularly scans the premises and compares each of its previous scan with the one that is at present. If it finds any difference it considers them and verifies and declares whether it is a trash or not. Thus they don't need any human intervention. The robot is built using commercial of-the-rack materials and components, free open source software and open source hardware. Robotics is one the ingenious technology of our time and has a notable bond to other growing technologies like autonomous machines, 3D- printing, cyber-physical systems, internet of things, renewable energy and so on [2]. It is aimed that the project will accord something to elevating environmental awareness, in helping clean up the environment. The robot is also provided with a mechanism to cleanse even the small dust particles that is left over after picking up the craps. The major idea behind this is to speed up the task and free someone from performing repetitive task so that they can force on intelligent activity. Today automation has gone so far that a whole factory can function with bots that are programmed to perform those tasks without manual interruption and just with human supervision.

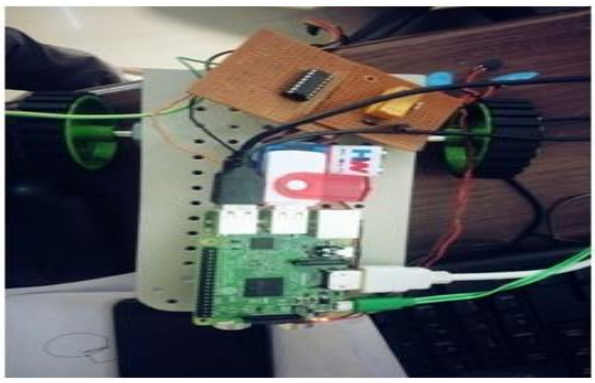

Fig. 3: Partial Implementation.

The second major problem with most of the robots in market is that they don't collect minute particles in and around them. Thus in our robot we have used a vacuum suction pump to gather minute particles which acts as the same way as that of vacuum cleaner, but differs in a way that they don't suck the dust into them but aside them. For this the same mechanism of vacuum pump is used with a pipe being out off the machine. The major feature of our robot which is not found in others is that obstacle avoidance. As our robot is completely autonomous it has to move around the system without colliding with any other object in its path. Thus for this, ultrasonic sensor is used, which provides path in which the robot should move. It is also featured with human avoidance or avoids the objects on its path which are not stationery. Thus they detect the obstacles on its way which are also in a move along with it, and without colliding with them.The major advantage of autonomous packrat is that, they can differentiate between biodegradable and non-biodegradable. For this we can use capacitive-proximity sensors. This helps us to separate the bio degradable from non-degradable and this can even be stored separately in the trash collector can and can be disposed accordingly. The stuffs and the constituents of the autonomous robot and their cost are listed in the table-1. It has surveyed that the robot is economic as it does not cost more than 350 USD.

Table 1: The Cost Evaluation of the Components Used.

Components and quatity	Specification	Cost (INR)
Trash can	D:355mm, L: 812mm	1,800
Materials	Wood,nuts& bolts, etc.	300
Wheels and casters	D:124mm,W: 31.75mm D:76.2mm, W: 25.4mm	1,200
LCD screen	7 inch, 5V	4,000
LED strip (1 m)	12V, 24W, 2A	200
USB speaker	5V, 5W	300
DC motors(2)	12V, 100RPM	2,500
Motor driver	24V, 5A	300
Battery	12V, 7Ah	900
ADC	4-channel, 16-bit	500
MQ7 sensor	5V, 150mA	400
MQ2 sensor	5V,800mW	300
PM2.5 sensor	5V,90mA	850
DHT11 sensor	5V, 2.5mA	200
Raspberry Pi 3	1.2GH Quad-Core ARM	4,050
USB webcam	VGA (640x480)	430
Game controller	2.4GHz Wireless	3,160
	TOTAL	21,090

4. Conclusion

This paper has presented an accorded, reasonable, inexpensive and contemporary robot systems for the use as movable trash that helps in keeping the surroundings clean and tidy. The design and development of the system is affordable at low cost since it uses open source economic hardware and free open source software. It incorporates air quality monitoring systems that gives additional information to us. It has the prospective for ubiquitous deployments and advanced improvements. In addition to this, our paper provides a solution for clearing the trash and it is capable of learning and advice against littering in the future. The robot we have designed removes both debris and large trashes. With the development of AI and training our robot it has a greater potential for further improvements.

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