

Omnibot

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Abstract- *Imagine that most robots are either rolling robots that roll things around, or robots that have arms that pick up things, but not both together without the robot making an awkward stop. Omnibot is a robot and it uses super adaptable mechanism wheels (move in all directions, and rotate very easily, so that they can roll sideways, diagonally, and rotate very easily). The Omnibot also has a simple fourjoint robotic arm that can accurately lift items that weigh up to 1.2 kg. We developed technical formulas so that we can use the two together to perform picking jobs such as picking up items off the shelf while rolling through aisles. Testing of the Omnibot in Robot Operating System (ROS) and with our Arduino prototype found that the Omnibot to runs it's pick and place job with 95% or better accuracy, decreases pick and place job times from 4 seconds to 2.8 seconds, and uses 28% less power than the clunky traditional robot with separate rolling parts or separate picking parts. This provides the ability to perform work in tight spaces (e.g., turbine rooms), where every second counts (convert this in cursive)*

Key Words: 1) wheels, 2) Robotic arm, 3) controller, 4) 3d printed parts , 5) Servo motors.

1. INTRODUCTION

We built the Omnibot because factory floors and power plants are really crowded. Robots that have wheels have a tough time getting around. They have to turn around in circles just to move a little to the side. This wastes a lot of time. The Omnibot is different. It can roll around. Reach for things at the same time. It can even grab things while it is moving.

This is a help, to workers. The Omnibot can do jobs that're dangerous and have to be done over and over again. For example it can check valves in engine rooms. This is a deal because it saves workers from having to do these jobs themselves.

2. LITERATURE REVIEW

Let me tell you about the Omni Bot. This isn't just any robot. It's a mix of precision, automation, and intelligence, designed to handle tasks that humans may find repetitive or risky. Think of it as a well-tuned machine, with every joint and link crafted to move with accuracy, like a clock.

Its kinematic chains form the backbone of its ability to manage objects without mistakes, whether it's assembling parts or moving materials. It's not just about moving. It's about doing it with a level of consistency that makes it feel like a partner in the workshop.

According to **M. P. Groover's**[1] work on automation aims to make factories smarter. The Omni Bot fits perfectly into that vision. It acts like a tireless worker who never gets fatigued, never makes errors, and can operate in areas where humans might feel unsafe. When it performs pick-and-place tasks, it's not only efficient. It's like the factory's invisible hand, taking over the mundane tasks so humans can concentrate on more creative or strategic work.

According to **B. Siciliano** and **O. Khatib** [2] discuss mobile manipulators, where the Omni Bot excels. It's not merely a stationary arm; it's a mobile platform that can move around, change its position, and respond to different environments. Imagine a robot that works flexibly, able to shift, reposition, and handle tasks in various layouts without needing a complete redesign. That's the benefit of combining mobility with robotic arms.

According to **R. K. Mittal** and **I. J. Nagrath**[3] point out that microcontrollers and motor drivers act as the robot's brain and muscles. The Omni Bot uses these components to turn commands into accurate motor movements. It's like having a conductor leading a symphony of gears and sensors, ensuring every move is smooth, quick, and effective. Without this integration, the bot would just be an empty shell—pieces without purpose.

Accor to **K. S. Fuetal**[4]., who stress that sensing, control, and intelligence are the main elements that make robots think. The Omni Bot isn't just a machine; it's a system that learns from its surroundings, adjusts in real-time, and makes decisions on the spot. It's like a robot that doesn't simply follow orders but understands the context, responds to changes, and improves with experience.

In summary, the Omni Bot is the result of all these concepts working together. It's not just a robot; it's a blend of engineering and artificial intelligence, designed to be efficient, resilient, and an integral part of modern

workflows. You might wonder how we can create something so precise and adaptable, yet so straightforward in its purpose.

3. WORKING PRINCIPLE

Movement and handling work together inside the Omni Bot. Instead of just rolling front to back, wheels driven by DC motors let it slide left or right too. These wheels might be regular ones or special omni type.

1. A robotic arm handles objects using several jointed parts, each moved by small servo motors - models like SG90 or MG995 fit here.
2. Thanks to those servos, the arm bends accurately at angles needed for grabbing things. Directing everything is an Arduino board, taking charge like a central hub. Commands reach this controller wirelessly via a piece of hardware called HC-05 Bluetooth module. Power flows where told, once signals arrive from that link. Movement of the wheels along with arm placement depends on these commands.
3. Instead of complex circuits, the L298N chip handles power delivery to the DC motors. Meanwhile, small servo units respond straight to pulse signals sent from the Arduino board. Power comes from reusable battery packs - common ones like 18650s keep everything running without wires. When working together, each part helps the machine reach a spot, grab something with its claw, then set it down where needed.

4. METHODOLOGY

1. Project Conceptualization

Beginning the work meant pinpointing a gap: machines able to move around while also manipulating objects. Following analysis of existing automated solutions, focus shifted toward an Omni Bot design - this combines mobility with an attached manipulator arm. Its core purpose? To execute pick-and-place actions through remote signals sent without wires. Decisions about structure relied on realworld constraints like budget limits, how practical it seemed, access to parts, and simplicity during assembly. Each choice shaped what eventually became the finalized approach.

2. Design and Analysis

During this phase, the robot's general shape and internal arrangement took form. For stability, a well-balanced frame was chosen to hold every part securely. Instead of simplicity, the arm featured several pivot points so

movement could be more flexible. Calculations helped estimate how much force motors needed, what weight the structure must bear, and which materials would last. Components such as power units, motion controllers, microprocessor, and energy source were matched carefully - each picked not just for function but also long-term dependability.

3. Manufacturing Process

Parts of the robot's body came from aluminum, along with mild steel or acrylic sheets. Shaping the frame involved cutting, drilling, then putting pieces together for stability. Motors, wheels, and arms found their places through custom mounts built into the design. For elements such as the arm or gripping tool, production happened via 3D printing - sometimes kit-based assembly filled that role instead. Alignment stayed precise across every piece so shaking or wobbling would not occur once movement began.

4. Electrical Integration

Wiring up every electronic part followed the planned circuit layout closely. Connected to the Arduino microcontroller: a motor driver, DC motors, servo units, alongside a Bluetooth module. To avoid loose links, each joint received careful soldering and secure placement. Energy came from 18650 lithium-ion cells, while regulators kept voltages stable when necessary. Movement logic for both robot body and mechanical arm ran via embedded C code on the Arduino, reacting directly to commands sent by users.

5. Testing and Validation

Following setup, tests ran across varied scenarios to measure how well the system operated. Wheel motion, arm responsiveness, and Bluetooth signals underwent inspection one after another. To position the arm precisely, servo motors received calibration adjustments midprocess. Errors showed up early - those got fixed before tweaks boosted overall balance, function speed, and handling accuracy. Several rounds of testing followed, each confirming more consistent robot behavior over time.

6. Cost Estimation

Beginning with each part - motors, Arduino, battery, frame supplies, electronic pieces - the full expense emerged through careful addition. Alongside these, money needed for building and putting together counted too. Staying low in price stood as a clear target, without letting function slip. Looking at numbers made it clearer whether wide use could work. Keeping education and real tasks in mind helped hold spending down.

5. COMPONENTS OF THE SYSTEM

Arduino:

Thinking like a central hub, it handles every command while managing each part. From there, directions flow to motors so movement happens along with arm actions.

1. DC Motors:

Faster spinning means quicker motion across surfaces. Spinning backward shifts path orientation opposite forward travel. Control comes from signals sent to circuitry managing power flow. Wheel turns create mobility for the machine piece. Direction changes happen when rotation reverses on command.

2. Servo Motors:

Start by guiding each joint of the robotic arm through exact angle changes. It lifts things while turning them, also holds items securely during motion.

3. Motor Driver (L298N):

When Arduino sends a signal, motion begins in one way or another. Power flows just enough to turn the wheels. Direction shifts happen smoothly without delay. Speed changes follow each new command closely. Current moves only when needed. Motors respond every single time.

4. Bluetooth Module (HC-05):

Wireless signals link the robot to a handheld gadget. From there, directions come through phones or controllers.

5. Battery (18650):

Running everything from chips to spinning parts. Keeps going without needing a wall plug.

6. Chassis:

Standing firm beneath everything, it holds each piece in place. Without wobbling, alignment stays true through steady support.

7. Gripper:

Objects get grabbed or let go through this system. Servo motors run the motions needed to lift and move items into place.

6. ADVANTAGES AND APPLICATIONS

6.1. Advantages

- Compact and portable

- Multi-functional system
- Easy to control
- Cost-effective
- Reduces human effort
- High efficiency

6.2. Applications

- Industrial automation
- Warehouse material handling
- Surveillance robots
- Pick-and-place operations
- Educational robotics

Table -1: List of Components

Sr. No	Component Name	Material Used	Function
1.	Arduino	Silicon , copper	Controls the entire system and processes commands.
2.	Chassis	Plastic	Provides support and structure.
3.	Gripper	Plastic	Hold , release ,grab
4.	Servo motor	Steel , copper	Move the arm
5.	Bluetooth Module	Silicon	Enable wireless communication
6.	Battery	Steel , lithium ion	Supply power to the system

Omni Bot rolls around on wheels while handling things with its mechanical arm, combining movement and gripping into one machine. Movement across floors happens thanks to small DC motors spinning the wheels, each turn guided by signals from inside. Instead of staying still, it travels where needed, grabbing items using a jointed limb powered by servos at every bend. At its core sits an Arduino chip making decisions, sending

instructions so everything responds when told. Bluetooth sends those instructions without wires, letting someone operate it from a distance if required. Designed to be small yet effective, it picks up objects then places them elsewhere – useful in factories or classrooms alike. Effort from people drops because tasks get done faster and more consistently than before. One goal stands out clearly – to show how robots on wheels can do useful work wherever they go. Arcing into motion through coded signals, mobile robotics take shape using an Arduino brain. Built around a robotic arm, these machines shift tasks once handled by people. Where dangers rise, automation steps in – quietly replacing hands with gears and logic. Embedded systems breathe function into metal frames. Wireless control links operator to device across empty space. Industries lean on such tools more each year. Intelligence grows inside moving parts, shaped by need.

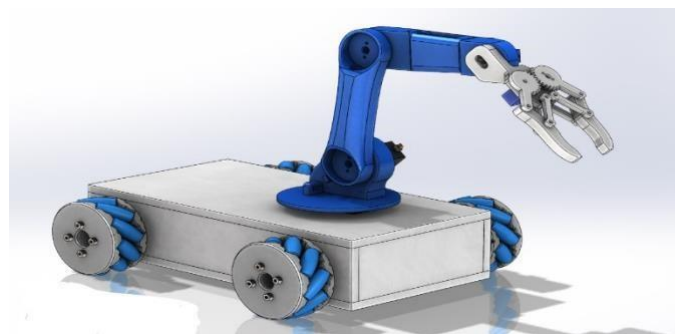


Figure no.01

actions. While wheels handle travel, the arm focuses on handling items, each guided separately yet moving together under shared logic. This blend of mobility and grip lets the machine respond smoothly to remote cues without pausing between steps. Powered by rechargeable batteries, like 18650 Li-ion cells, it runs without needing constant power. Because every part works together smoothly, the robot moves around on its own. A gripper handles picking up items. After grabbing something, placement happens exactly where needed. Efficiency comes through precise coordination across functions.

One big plus of the Omni Bot? A small footprint that fits tight spaces. Thanks to its adaptable layout, shifting tasks feels smooth. Operation stays simple, so users pick it up fast. Money saved shows up right away compared to pricier setups. Less handwork needed where dull or risky jobs pile up. More gets done when machines handle repeat work. Factories move goods using these bots every day. Warehouses stay busy keeping stock moving without delays. Security teams watch areas with help from rolling units. Schools let students try robot basics through hands-on builds. First step means spotting what needs fixing. Next comes picking an approach that makes sense. Plans take shape only after sketching options. Parts get chosen once goals are clear. Wiring paths form before any code runs. Logic flows follow written instructions later. Putting pieces together happens mid-way through. Final checks confirm everything works as expected. A working model starts with ideas weighed by budget and do-ability. Next up, engineers sketch out parts that move along with circuits, linking these blueprints before any software gets written. Once pieces come together physically, testing kicks in – tweaks happen here and there so everything runs without hiccups. Smooth performance? That comes from careful tuning after the build.

Using CAD tools shapes how the Omni Bot looks and fits together, showing every piece clearly prior to building. Stability comes first in the frame's layout, holding motors firmly along with the moving arm attached. Instead of fixed positions, the arm uses several rotating points so movement stays flexible across tasks. Before any part gets made, the digital version reveals flaws early through careful inspection. Combining smooth travel with precise handling defines what this machine does well overall. Down the line, sensors could join the setup – maybe even cameras tagging along later. Robotics books might show up as helpers here, alongside guides from the Arduino world. Papers written by researchers often lend a hand, plus there are web spots packed with know-how. Smarts running on AI? That idea waits in the wings, possibly stepping in when ready.

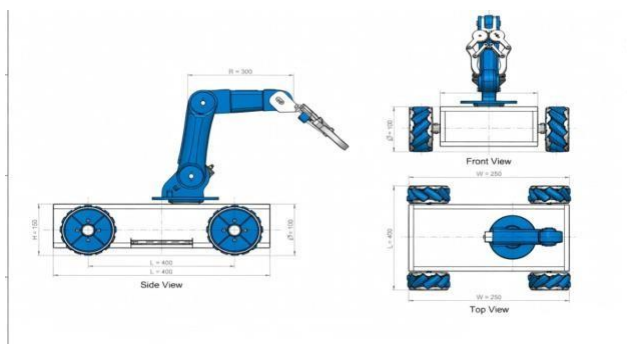


Figure no. 02

Inside the Omni Bot, motion begins with wheels turned by DC motors – capable of going front, back, or even sliding sideways. These movements come alive when power flows from an L298N chip that directs electricity based on commands arriving via HC-05 Bluetooth. A small but strong robotic arm sits above, built with rotating joints driven by SG90 or MG995 servos for accurate lifts and grabs. Instead of one isolated part doing all the thinking, control spreads across pieces – one key player being the Arduino, which links wireless messages to physical

7. CONCLUSION

Omni Bot moves around smoothly, then grabs things with its arm – no fuss. Built on wheels plus a gripper, it handles jobs needing motion and touch. Instead of just one trick, it switches between traveling and lifting objects fast. Arduino runs the show behind the scenes, linking circuits to moving parts. Mechanical bones meet electric brains inside this compact setup. Precision matters when placing items, so it adjusts carefully every time. Real environments test it well, yet it keeps working without pause. Tasks once done by hand now happen through coordinated signals and joints. Movement flows into action, each step timed within tight limits. Not magic, just smart engineering packed in a rolling frame.

Starting with basic parts cuts costs while opening doors for students and labs alike. Effort drops when machines take over tasks people used to do by hand. Accuracy climbs because automated actions repeat without mistakes. In risky places like factories or toxic zones, letting robots move instead keeps humans safe. Building on this base later could mean adding cameras that help the robot see where it goes. Sensors might let it respond to changes around it. Even now, what's built works well enough to show how bigger systems function. Upgrades down the line will likely expand where it can be useful. Simplicity here doesn't limit potential – it invites growth.

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