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Development of Robotic Arm with Suction and Grinding Mechanism for Sewage Cleaning

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Abstract: ***The current enhancement in robots has enabled robotic technology to find a solution to many practical problems that humans experience in their routine life, activities. The well known fact about a robot is that it works and looks like a human being. In present industrial technology, we are marching towards robotization. Certain industrial robots may not look the least bit like a human being although the research is directed to perform more human like features and super-human capabilities.[2] Generally, man enters into the manholes and removes the waste sludge. Here robotic arm can be designed for a sewage treatment progression. It becomes a bit difficult process to clean the sewage manually without getting any help from the humans. The main cause of sewage treatment process is to remove the waste constituents of polluting loads like solids, organic carbon, nutrients, inorganic salts, metals, pathogens etc. The ultimate goal of wastewater management is the protection of the environment in a manner commensurate with public health and socio-economic concerns. Effective wastewater collection and treatment are of great importance from the stand point of both; environmental and public health. Sewage treatment operations are done by various methods in order to reduce its water and organic content. Hence all these problems have been analyzed, considered and segregates the sludge from sewage using the six axes robotic arm.***

Keywords: Motor, Six Axes Arm, Detection, Grinding, Pick And Place, Suction

I. INTRODUCTION

According to the survey conducted in United Nations, nearly 2 million tons of sewage waste in dumped into the world's waterways. The wastewater that goes straight into the rivers affects the downstream populations widely. The true danger is untreated waste water brimming with bacteria and other parasites, many of which cause deadly diseases.[5] Manual scavenging exists because India is a resource rich country and a large human resource and a dearth of jobs. According to Harnam Singh, the chairman of the Delhi Safai Karamchari Commission, almost 70 percent of the manual scavengers die on the job. In these cases, without a remarkable safety precautions like, the disposal of wastes that are dangerous, radioactive substances, remote gripping of volatile devices and the captive situations among others the pick and place robots, often termed arm robot can be used. In existing system, before many years people enter the manholes in order to clean the wastes. Due to less supplies of manpower for cleaning the sewage we used the motors and tanks for removing the waste dumped in the sewage.[7] Then the technology took a great control over the century and we used the robots to clean the sewage waste and dumps. The biggest disadvantage of the robots are it only takes the wastes but it doesn't dig out the muds that are in dumps which are seemed to be in form of rock solids due to deposition of slits.[7] And also it doesn't have the monitoring system to monitor the sewage in case of heavy rainfall the sewage will overflow with water and exceeding out and causing a environmental degradation and also causing illness to people.

II. SYSTEM ARCHITECTURE

This system attempts to completely clean the drainage that

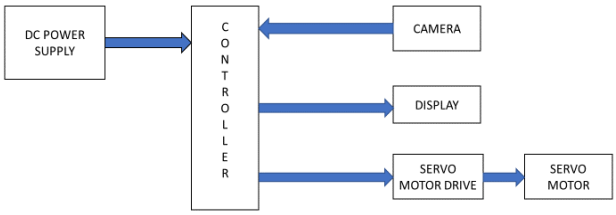


Figure 2.1 Complete block diagram is comprised of rock solids and thereby by monitor overflow of drainage water without manual interruption.[3] The block diagram comprises of DC power supply, Controller, Camera, Display, Servo motor and Servo motor drive.

A. Detection And Actuation

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving cost and time to market. The Raspberry Pi 3 Model b+ maintains the same mechanical footprint as both the Raspberry Pi 2 Model B and the Raspberry Pi 3 Model B.

Fig 2.1 Raspberry pi 3b+

The camera is connected with raspberry pi controller and interfaced with robotic arm and the code to run the process is uploaded into this raspberry pi 3.The code or program follows Adafruit algorithm.

B. Raspberry PI Camera Module

The Raspberry Pi Camera Module is a custom designed add-on for Raspberry Pi. It attaches to Raspberry Pi by way of one of the small sockets on the board upper surface. This interface uses the dedicated CSi interface, designed especially for interfacing to cameras. The board itself is tiny, at around 25mm x 20mm x 9mm. It also weighs just over 3g, making it perfect for mobile or other applications where size and weight are important. It connects to Raspberry Pi by way of a short ribbon cable. The sensor itself has a native resolution of 5 megapixel, and has a fixed focus lens onboard. In terms of still images, the camera is capable of 2592 x 1944 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video. The camera is supported in the latest version of Raspbian, Raspberry Pi's preferred operating system.

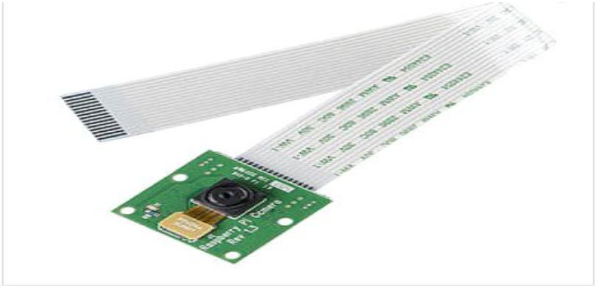


Fig 2.2 Raspberry Pi Camera Module

C. Switch Mode Power Supply

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or SWITCHER) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads such as a personal computer while converting voltage and current characteristics.

Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor.

This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.
Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor. Here 12v to 5amp is used to control the supply for arm and to withstand the load. Switch mode power supplies (SMPSs) are used in a range of applications as an efficient and effective source of power. This is in major part to their efficiency. For anybody still working on a desktop, look for the fan output in the central processing units (CPU). That's where the SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of electronic gadgets. Basically, it is a device in which energy conversion and regulation is provided with semiconductors that are continuously switching "on" and "off" with high frequency.

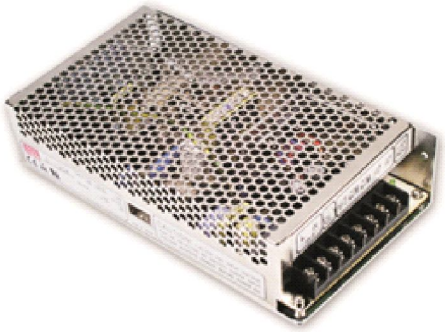
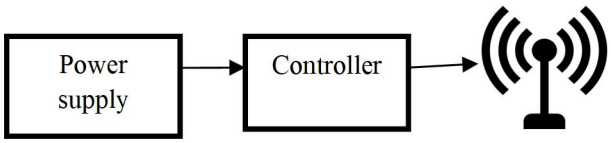


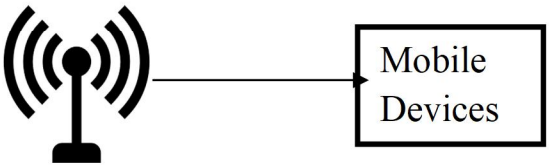
Fig 2.3 Switch Mode Power Supply

D. Transmitter Section



The transmitter section works out with the controller that gets the information through the camera and sends the feed into any portable devices such as mobiles, tablets etc through the wifi network.

E. Receiver Section



The receiver section only consists of the mobile devices that are connected to the wifi network that gives the information of the data in the sewage and makes the movement from the outer surface to clean the sewages.[2] So with this we can easily clean the sewage and it will be easy for handling.

F. Servo Motor

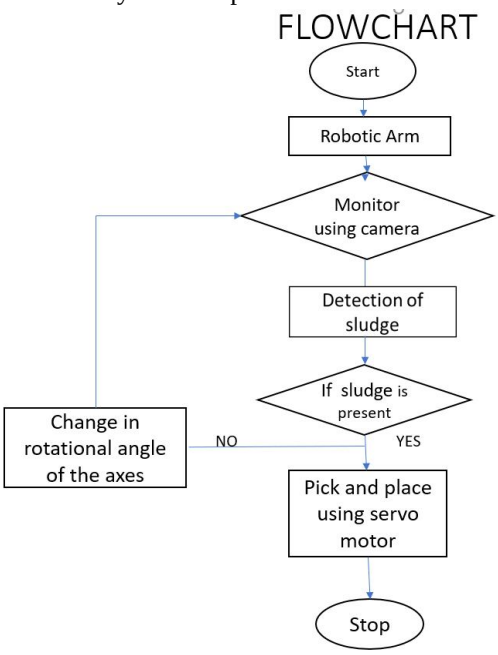
A servomotor is a rotary actuator that does precise control of angular position, velocity and acceleration. It also requires a relatively sophisticated controller often a dedicated module designed specifically for use with servomotors. Generally, a servo motor is a type of dc motor that works upon receiving a signal of a certain frequency, can rotate itself to any angle from 0 to 180 degrees. In order to control a servo motor, we are using a technique called Pulse Width Modulation (PWM). In Pulse Width Modulation technique, a pulse of variable width will be sent and the position of Servo motor's shaft will be set by the width and length of the pulse. Here, interfacing a servo motor with Raspberry Pi is a beneficial process to handle complex projects like Web Controlled Servo, RC

Robots. So in this project, we've implemented a simple control of Servo motor with the help of Raspberry Pi. These servo motors are used in robotic arm to be worked in all mechanical directions. A servomotor is a closed-loop servo mechanism that uses position feedback to control its motion and final position. The input to its control is either an analogue or digital signal corresponding to the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is differentiated with the command position and the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As positions approach, the error signal reduces to zero and the motor stops. The very simplest servomotors use position sensing via a potentiometer and bang-bang control of their motor; the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models. More sophisticated servomotors use optical rotary encoders to measure the speed of the output shaft and a variable-speed drive to control the motor speed.[3] Both of these enhancements, usually in combination with a PID control algorithm, allow the servomotor to be brought to its commanded position more quickly and more precisely, with less overshooting. The three main process involved in this process are

1) *Gripper:* The gripper is used to carry the garbage's or waste with a grip and store it. And move away the garbage's with safety. A gripper is a device that enables the holding of an object to be manipulated. The easier way to describe a gripper is human hand. Just like a human hand, a gripper does the holding, tightening, handling and releasing mechanisms with an object. A gripper is one of a component in an automated system. It can be part of the fixed automated system where they are several existing model. The most popular style of gripper used in this case is two jaw parallel gripper that provide two mounting locations for the fingers that comes in contact with the part to be grasped. The jaws move in synchronous motion opening and closing towards the central axis of the gripper body.
2) *Grinding:* Grinding is an abrasive machining process that uses a four sided grinding blade as grinding tool. Here, the grinding part is used to grind the mud that are formed as solids due to slits in the garbages.[1]
3) *Suction:* Suction is the force that exerts upon semi solids. When the pressure in one part of the system is reduced related to another, the fluid in higher pressure region will exert a force related to the region of lower pressure. Pressure reduction may be static or dynamic. This suction part sucks out the drainage water from the sewage and moves away carefully.

III. IMPLEMENTATION STRATEGIES

The implementation of this process involves in the flow of detection, grinding, picks and places the sewage. To initiate power supply is provided through SMPS and voltage regulator to regulate the voltage and thus the camera is enabled. camera is applied to detect sludge automatically and to carry over the process.



A. Working Methodology

When the process is initiated, the robotic arm rotates about 90 degree and return back to original zero degree. Then camera is enabled and the sewage is monitored using camera, so that detection of sewage is done through camera interfaced. If sewage is detected other joints at arms moves towards sewage to pick and place. If sewage is not detected then there will be change in rotational angle of axes until the camera detects. If the sewage is solid, it is grinded using grinding blades. The process of picking and placing can done by using grippers and thus the process continues**.**

1) Advantages

a) It is used to safeguard the environment from the degradation due to sewage waters.

b) It saves the human life death rate due to improper safety measures for cleaning the sewage.

c) It also monitors the overflow of drainage of water.

2) Disadvantages

a) Cost effective.

b) It requires humans with skill to operate the machines to clean the sewage.

3) Future Scope: The future scope of the project is to make the camera work in immersed sewages and give clarity images.

IV. RESULTS AND OUTPUT

The output the of the circuit is given in the figure 5.1. The six axes robotic arm detects, grinds, picks and places the sewage automatically without the help of other human interventions. The time taken for arm is similar for almost all weights. This arm can hold upto 5.2 kg and every motors can rotate to maximum of 180 degree.

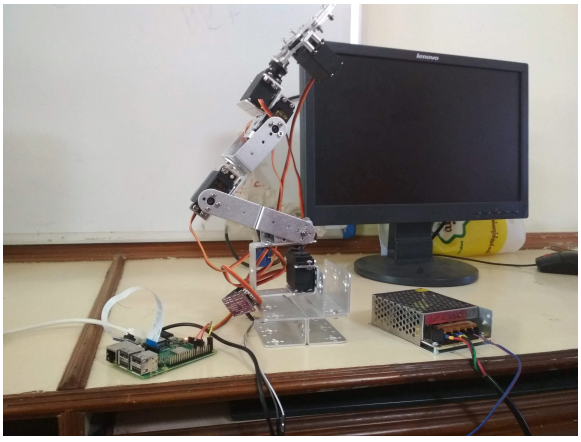


Fig 4.1 Six Axes Arm With Connections

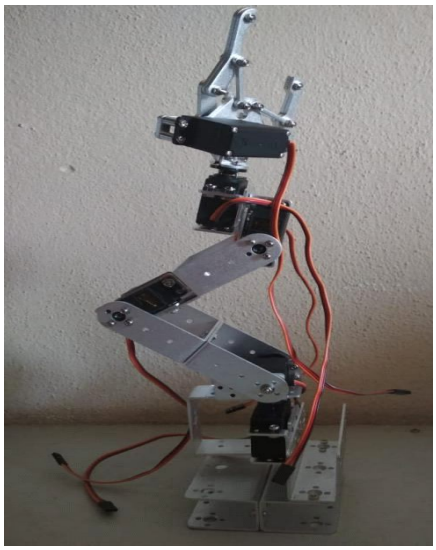


Fig 4.2 Prototype of Arm

V. CONCLUSION

By implementing this concept of intelligence drainage cleaning method there will be reduce in the manual scavengers in our country which reduces the health hazards for humans thereby reducing the environmental pollution in our country. Though the initial setup may cost high it gives healthy environment for us and for our future generation.

VI. ACKNOWLEDGEMENT

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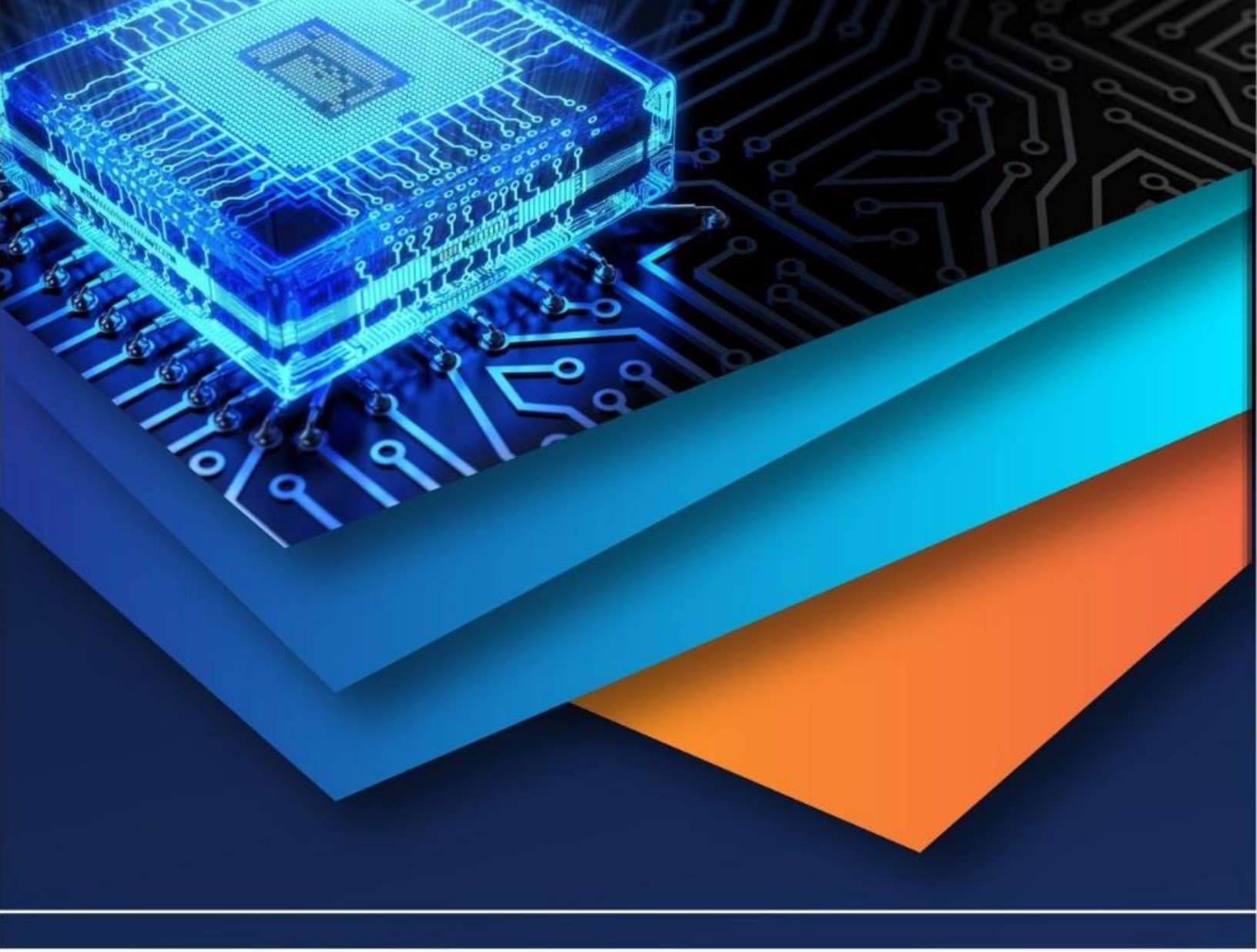

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