SMART WASTE MANAGEMENT SYSTEM

ABSTRACT

Waste Management became a challenging problem in Sultanate of Oman and Worldwide. Most of the solid waste in Oman is a large percentage of the recyclable materials. Waste management system is a system used to automatically organize solid waste and dispose of it in different garbage bins to ensure more efficient recycling process. The aim of this project is to isolate the recyclable waste by separating the materials. When the user adds the waste into the collecting duct, the system identifies the material type whether it Dry, Wet or Metal, with help of the Arduino UNO and the sensors attached to the machine. After this stage, the system rotates 270° with the help of the servo motor to allocate the required bin. The LCD that is attached to the machine, shows the process of the system. However, the LCD can be used also for the commercial usage such as applying Ads, as we know the machine is placed in Residential areas. Additionally, the project has been implemented to IOT System, which now can send notification to the administrator room to collect the bin once it's fully packed.

Keywords: Waste Management System, collecting duct, Arduino UNO

Introduction

Waste Management is a challenging problem in sultanate of Oman. In every year more than 1.7 million tons' solid wastes are generated from the population of 3.9 million residents over here. The municipal waste is around 4700 tons per day. The most of solid wastes in Oman are considered as a large percentage of recyclables. paper and cardboard (15%), plastics (20.9%), metals (1.8%) and glass (4%) (Source: Waste Characterization and Quantification Survey, Be'ah, 2013). The solid waste can cause serious health issues and higher potential for infection. Back in the days, the waste used to be dumped along roads and public-dumps, in poor-populated-areas, which caused toxic gas ends up effecting the lungs and skin, as well as other health issues.

Waste Management System is a system used to organize the Recycled waste materials to make the Recycling more efficient and effective. This System basically, separates the solid waste into different bins atomically to make sure the recycling process is more efficient. Besides, lowering the cost of the process because as known the normal process cost a huge amount of money due laborers.

Related Work

The main contributions of our work are to solve waste issue in our community, even if the issue is not fully settled, but at least we had the chance to be part of the solution as responsible youth students. The project is designed not only to determine the waste also to reduce the time and effort for the laborer's due to the alert feature, that alerts the administrator of the bin location once it full. Nowadays, the technology has proven itself in the past few years and the traditional bins isn't the best option for the recycling process due to the less accuracy and less efficiency (Aceleanu, 2019).

Implementation Details

At the beginning, the System starts by turning on the switch which is connected to the power supply. Then the user adds the waste in the collecting duct, so the waste can pass through each sensor. If the Metal Sensor have detected a waste, then the Servo Motor rotates to a certain angle to push the waste through the required bin. However, if the Metal have not been detected, then the moisture sensor activated and measure the humidity temperature in order to find out if it is wet or dry waste, if it is wet. Then the servo motor does the same procedure and place it to the required bin, and if not. So, the system immediately considers it as dry waste. After this step, the type of the waste will appear in the LCD so that the user could know what was the waste. In fact, LED's also glow when the waste is found. However, each type of waste has its own LED's color which make also the tracking much easier. The third stage of the system is, when the bin is full the LCD gives a notification that the type waste his bin is full which also sends an

SMS to administrator to collect the bin. This stage happens, if all the other stages is successfully done without any issues in between otherwise the system will shut down or stop.

Results

The figure 1 demonstrates the Current flow of 5mA and the Voltage of 5V for each sensor, this ensure that each sensor has the right amount of voltage to prevent from an unnecessary risk, such as overload and getting damage. In fact, the resistors that have been placed in each sensor helped for stabilizing and reducing the amount of current by placing 1kΩ Resistor each.
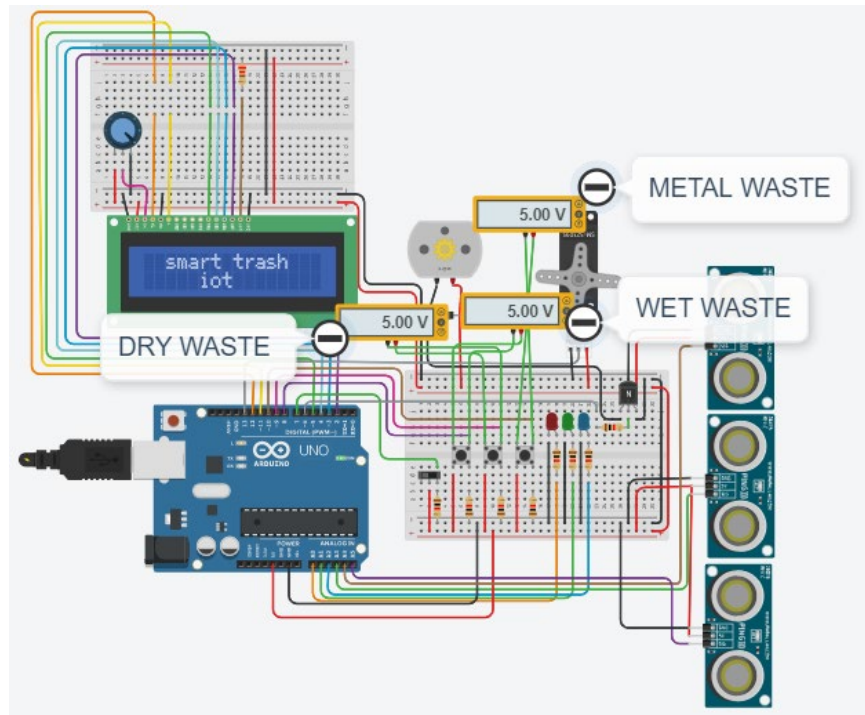
Figure 1: Checking Voltage

Figure 2 and 3 shows the motor condition of the RPM of the Motor change, once the simulation starts. Which is basically, the belt that holds the waste towards the bin. In fact, the difference between both Screenshots above, that Figure 2 shows at the beginning of the simulation and figure 3 shows how the RPM is increasing once a waste has been detected in order to push the waste towards the bin, as shown in the LCD (Wet Waste).
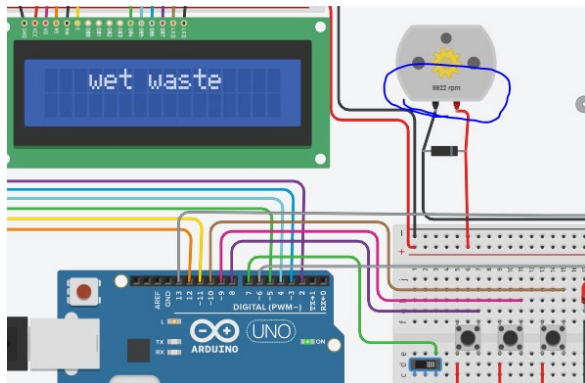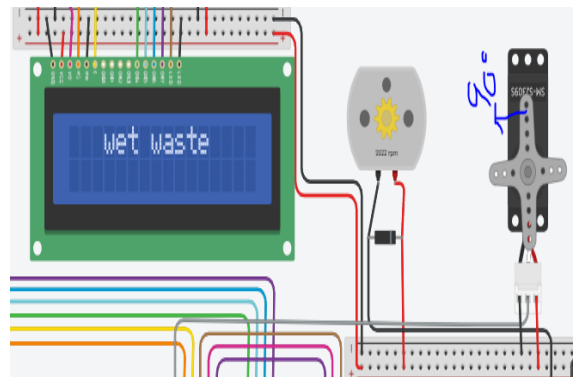

Figure 2: Motor Condition

Figure 3: Servo Motor wet waste

In this task, the purpose of the Servo Motor is to allocate the bin location as shown in the screenshots of figure 2 . Moreover, the wet waste has been identified the location of the bin as 90° towards the wet bin In fact, the servo motor pushes the waste by the help of the motor belt towards the required bin. For the dry waste, the servo motor change its position and rotates 120° to towards the dry bin. Same thing is happening for the Metal waste, once the system has finally identified or detect the Metal waste the servo motor rotates towards the metal bin which is 180° .

Figure 4 shows the working of the LCD depends on the sensor condition on wet waste, dry waste, and metal waste. The LCD not only displays the waste when its detected, also it displays when the bin is full.
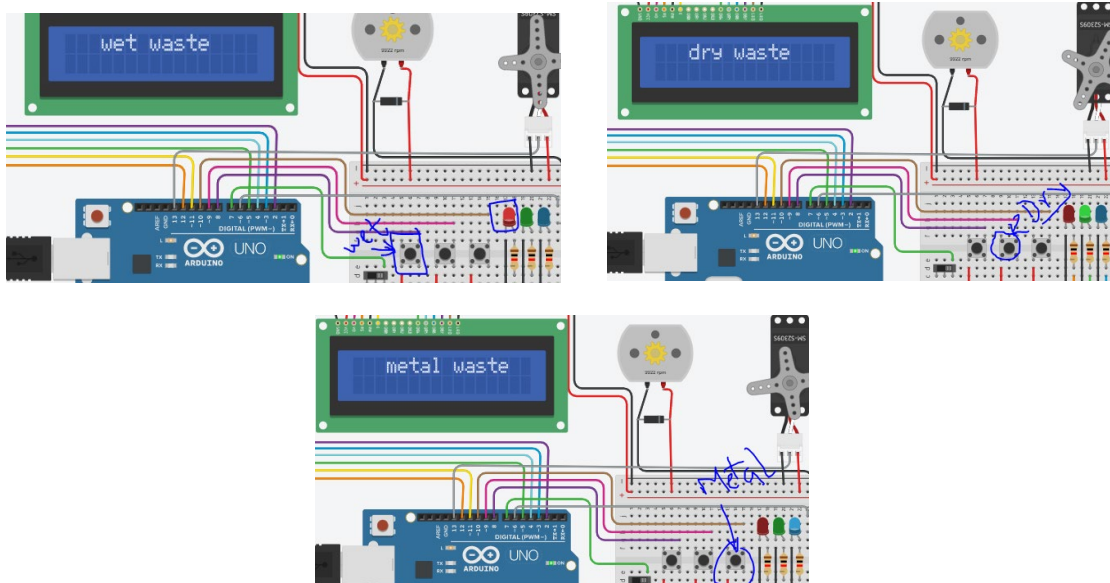

Figure 4: Servo Motor wet, dry and metal waste segregation

The LEDs glow depends on the type of the waste the has been detected.

When the bin is full a notification alert is send via SMS and WiFi. However, this process occurs once the bin is fully packed, in order to notify the administrator to collect the bin. This step is important especially in commercial usage. Figure 5 demonstrates this
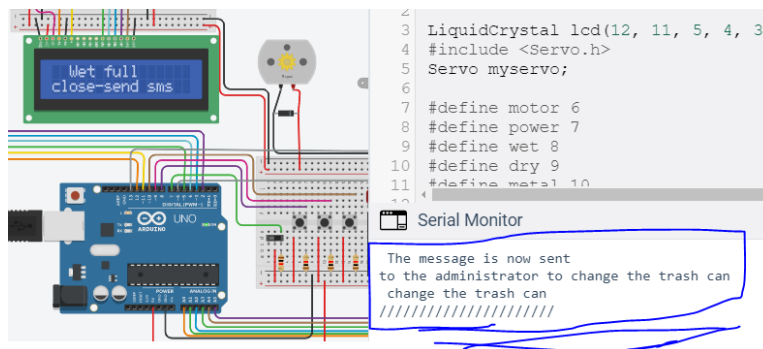

Figure 5: Check the SMS Notification and WiFi

Discussion

The figure above shows the Software Simulation of the System. The working of the system will be explained during the presentation time and for further more information the link is provided to shows the software itself. https://www.tinkercad.com/things/jUsNtFr1zQ9-ahmad-mazen/editel?sharecode=CDUHXocbXwg4LYgNJDccI_quHFcll33rWFfhUzXefW0. In fact, the system works perfectly fine and as what planned for. Therefore, the hardware device still didn't achieve due to the certain pandemic and the college policy have agreed for the software prototype in the bachelor's project.

Conclusion

The project aimed to design an affordable and effective waste management system using Arduino Uno Technology. Although, system with similar function have already been patented, it's always a good idea to work on system improvements. By reviewing different methods that were previously implemented, as well as the merits and the drawbacks of each method, it becomes possible to make improvements especially with the technology developments. In fact, the project is designed to solve serious problem in our century due to the population growth which leads to high resource consumption. The selection of waste management system was based on the fact that carried many advantages when compared to other traditional techniques like human manpower and basic equipment's and so on. Overall, the project met all of its written goals and performed as planned.

Limitation

After designing and implementing the project idea, turned out the project still have a space for improvements for helping this idea to be more efficient in the real time usage. In the first part of the project, the system segregates only one waste at a time. Therefore, the buffer space can be used to isolate mixed waste types. Since the sensing time for metal objects is short, the entire sensor unit can be placed along one platform where the object is stable to ensure better results, which makes the process much slower and less efficient especially in some industrial usages. However, the system detects three types of waste only. Dry, Wet and Metal. In fact, this doesn't give the system the ability or the authorization to identify between the Dry objects it only checks the humidity for the waste, for example wood, plastic, paper considered as dry waste, which make the dry bin have different types of dry objects needs to be organized, same thing in the wet waste. Overall, the system is only a sample for the developers or the investors to create the system depending on their goals. Yes, there are space of improvements and developments. The project can be use as robotic hand in the future, which can be designed as robot that have arms that filled with sensors to collect or pick a certain type of material automated without the human intervention, this is one idea of the many ideas that can be done with this project (Sukumarana ,2020).

Acknowledgments

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