SMARTBIN

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***Abstract*— This study suggests utilizing technology to address the problems with trash management. Nowadays a large amount of waste that is generated and disposed has an adverse effect on the environment. As we observed in our campus, dried green leaves and papers etc... Are thrown in unwanted areas. This dumping is dangerous to human health, plant and animal life. The proposed method of approach will solve this issue. Integrated moisture sensor into a FPGA kit to detect wet or dry waste while using a conveyor belt to segregate waste into respective bin compartments. This approach helps to reduce the time spent on waste segregation.**

***Keywords*— Spartan 3, Ultrasonic Sensor, Moisture Sensor, Conveyor Belt, DC Motor.**

I. INTRODUCTION

The amount of waste produced and disposed of today has a negative impact on the environment. As observed in our campus, dried green leaves and papers etc. are thrown in unwanted areas. This dumping is dangerous to human health, plant and animal life. The proposed method of approach will solve this issue. Integrated ultrasonic sensors and a moisture sensor into a FPGA kit to detect object and moist while using a conveyor belt to segregate it. This approach helps to reduce the time spent on waste segregation.

Due to its role in the spread of natural diseases, pollution, and other issues that need to be addressed, waste management has not received the full attention it deserves in the current trend. Usually, this waste management process starts out as a manual one in which waste must be manually divided into the seven various categories. Waste categorization involves a variety of studies and generalizations that vary from region to country.

Waste decomposition generally falls into five types. They are: Hazardous, Recyclable, Organic, Liquid, Solid, and Organic Waste. According to a study on waste management, it is believed that the rise in municipal solid waste has become a significant environmental issue, and that the amount of excessive trash is now rising along with the population. The analysis is based on data from businesses, industries, and residences. The major goal of this research is to raise awareness of a straightforward, reasonably priced, and user-friendly separation system for usage in urban households, commercial establishments, and industrial settings to streamline waste management.

For a separation and alarm system at centres, a smart dustbin that is affordable, simple to use, and can be transmitted directly for processing is needed.
The problems that stand between the waste management system's ideal execution and its practical application for sustainability are the idea behind it.

II. LITERATURE SURVEY

The literature review yields an idea for creating a module. There have been numerous studies conducted in the area of choosing apps. In the first section, some groundbreaking studies conducted to identify the optimal methodology were briefly covered. Analyzing papers on connected subjects, as well as studying and describing various protocols and methods.

Only a few prototypes demonstrate how the conveyor belt rotates when the ultrasonic sensor detects waste when it is deposited. When waste reaches the Eddy current proximity sensor, the conveyor belt stops moving and the metal bin compartment rotates forward so the waste can be dropped in. If the sensor detects metallic waste when the waste reaches the sensor, it sends a signal response to the Arduino microcontroller to validate the waste state. The waste passes to the capacitive proximity sensor as the next sensor if the sensor response is low.

The belt stops moving and the bin rotates to the recyclable bin compartment so that the waste can be dropped by the belt if the capacitive proximity sensor determines that the waste is recyclable or made of a capacitive holding material. The belt transfers the waste to the moisture sensor if the reaction is LOW.

When trash comes into contact with the sensor's probes, the sensor sends a signal to the Arduino so that it may read the resistance value of the waste and determine the waste's status based on that value. If it's moist, the moist bin compartment rotates forward and the garbage drops in; if it's not, the scrap bin, which is the first bin compartment, takes the waste that none of the sensors can detect.

III. System Overview

A. Block diagram

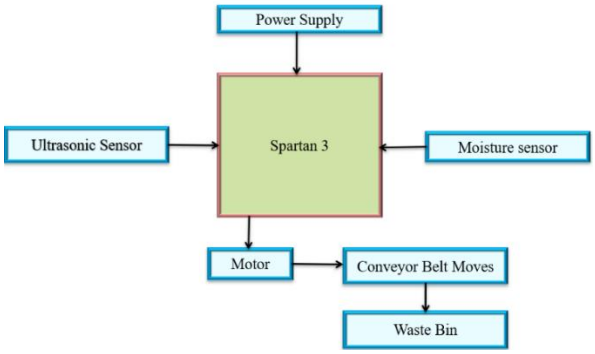

Fig 1: Block diagram Smartbin

When waste is placed, an ultrasonic sensor detects it, alerting Spartan 3 to the presence of the waste and turning the conveyor belt. The belt moves the garbage to the moisture sensor if the reaction reaches Spartan 3. When waste comes into contact with the sensor's probes, the sensor sends a signal to the Spartan 3 so that it may detect the resistance value of the waste and determine the waste's status based on that value. If there is any moist material, it qualifies as wet waste and goes into the wet bin section.

The sensors used in this prototype must be mounted on the top frame of the conveyor belt in order to detect waste and classify it.

IV. Material and Methodology

A. Material:

FPGA KIT (Spartan 3), Field programmable gate array is referred to as FPGA. It is an integrated circuit that the user can programme for a particular purpose. Sensors (Ultrasonic, Moisture Sensor), DC Motors, Speed regulator, Conveyor belt & Bins.

a. Ultrasonic Sensor*:* Like bats, the HC-SR04 ultrasonic sensor employs SONAR to calculate an object's distance. It provides exceptional non-contact range detection from 2 cm to 400 cm or 1 inch to 13 feet in an easy-to-use compact with high accuracy and consistent readings. Although soft materials like cloth can be challenging to detect acoustically, the operation is unaffected by sunshine or dark materials. An ultrasonic transmitter and receiver module are included. The ultrasonic sensor can estimate the distance to a variety of items regardless of their shape, color, or surface texture in addition to detecting garbage. This will find waste that is between 1 mm and 100 mm distant from the sensor.

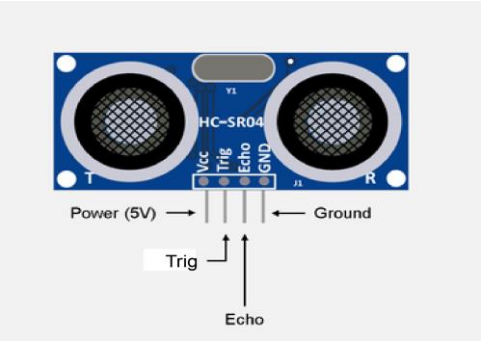

Fig 2: Ultrasonic Sensor

A.

b. Moisture Sensor*:* One type of inexpensive electronic sensor used to determine the moisture content of the trash is a moisture sensor. The Sensing Probs and the Sensor Module are the two primary components of this sensor. The probes let the current flow through the waste before measuring the resistance in accordance with the amount of moisture present. The Sensor Module receives data from the sensor probes, processes it, and outputs the result as either a digital or analogue signal. Consequently, the Moisture Sensor can offer both an Analog output and a Digital output (DO) (AO). The moisture content of the waste can be determined by the moisture sensor. The garbage can be detected at a distance of 10 mm from the sensor. Basically, a moisture sensor is used to determine whether waste contains moisture or not, such as a half-eaten apple, a full apple, a banana peel, a spoon of cooked rice, wet tissues, an uncut carrot, a cardboard roll that has been soaked in water, a piece of paper that has been soaked in water, an orange peel, and a tomato slice.

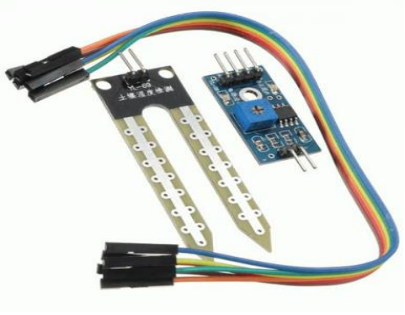

Fig 3: Moisture Sensor

c. DC Motor*:* An electrical motor that transforms direct current electrical energy into mechanical energy is known as a DC motor.

Fig 4: DC Motor

d. Speed Regulator**:** The speed of the DC motor decrease with an increase of load on the motor. This is not desirable. Therefore, there must be a lesser speed difference between no-load to full-load operations. In fact, every moving machine has some drop in the speed with load increase.
It is desired that the motor speed should be constant throughout the speed range of the motor with an application of the variable load on it. When the motor runs at no-load its speed is more, and speed drops as the load on the motor increases. The DC motor's ability to regulate speed between no-load and full-load conditions is known as speed regulation.

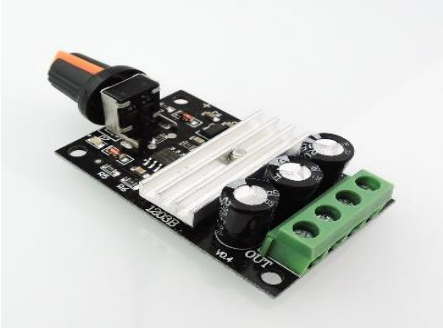

Fig 5: Speed Regulator

e. Conveyor belt*:* One continuous length of material is held by two or more pulleys in a basic belt conveyor. Conveyor belt of length 50cm is required. It is used to move waste material to different bin compartments based on sensor signals.

Fig 6: Conveyor Belt

f. Field Programmable Gate Array (FPGA): A two-dimensional array of logic blocks and connections between the logic blocks can be found in an FPGA. The interconnects and logic blocks can both be programmed. To perform a desired function, logic blocks are programmed, and switch boxes are used to programme the interconnects that connect the logic blocks. A complex design, like a CPU, is broken down into smaller subfunctions and implemented using one logic block for each subfunction.

It is necessary to connect every sub function used in logic blocks, and programming is used to do this. FPGAS can be utilized to implement a full System On One Chip as an alternative to custom ICs (SOC). The ability to reprogram is FPGA's key benefit. An FPGA can be reprogrammed by a user to implement a design after the FPGA is created. The term "Field Programmable" is therefore introduced. Custom ICs are expensive and takes long time to design so they are useful when produced in bulk amounts. But FPGAs are easy to implement within a short time with the help of Computer Aided Designing

(CAD) tools.

Fig 7: FPGA KIT

B. Software: An electronic circuit's structure and behaviour can be described using a specialised computer language called a hardware description language (HDL), which is most frequently used to describe digital logic circuits. It permits the automatic study and modelling of an electronic circuit through the use of a detailed, formal description of the circuit.

Electronic design automation (EDA) systems include HDLs as a fundamental component, particularly for complicated circuits like programmable logic devices. as application-specific integrated. It is of two types - Verilog and VHDL. The two languages differ in the manner in which they are written and their roots.

The simulation procedure is carried out using the Xilinx ISE 9.2i software. Simulation is a method used to confirm the functional validity of a digital design. The American technology company Xilinx is well known for creating the field programmable gate array and is primarily a supplier of programmable logic devices (FPGA).

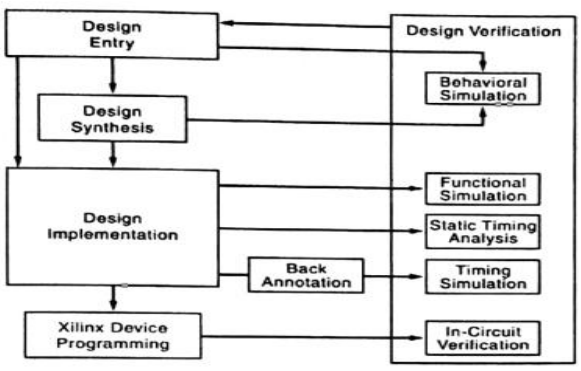

Fig 8: Software block diagram of Xilinx ISE 9.2i

V. RESULTS AND CONCLUSION

The developed SMARTBIN mainly concentrates on waste segregation and management. Integrated moisture sensor into a FPGA kit to detect wet or dry waste by using a conveyor belt to segregate waste into respective bin compartments. Low-cost sensors are used to gauge the design's effectiveness.

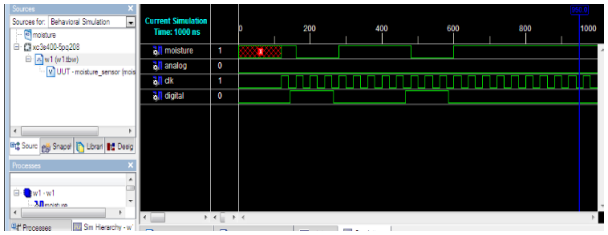

Fig 9: Represents the snapshot of Moisture Sensor Simulation

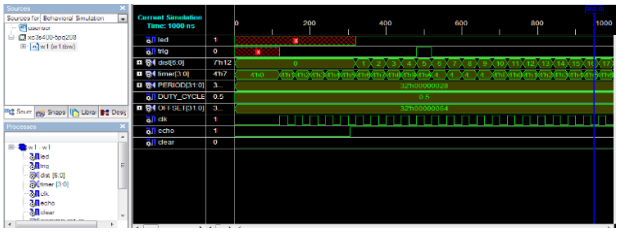

Fig 10: Represents the snapshot of Ultrasonic Sensor Simulation

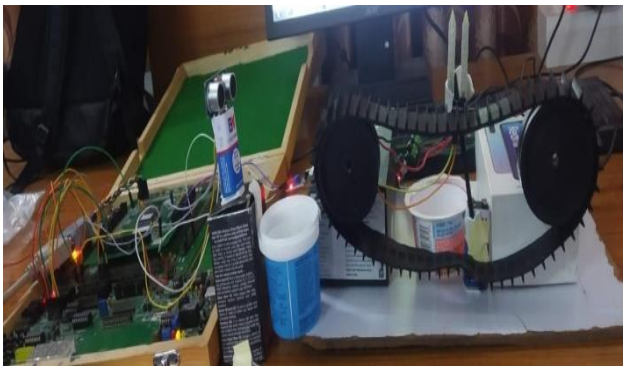

Fig 11. Overview of the model (Smartbin) and Ultrasonic and moisture sensors detecting object and moisture content in object.

Conclusion: The developed SMARTBIN focuses mostly on waste management and segregation. Using a conveyor belt to separate garbage into corresponding bin compartments, a moisture sensor integrated into an FPGA kit can determine whether waste is wet or dry. Low-cost sensors are used to gauge the design's effectiveness.

REFERENCES

[1] O. Shaimaa, M. Happened, M. Horttanainen, and J. Sorvari, "Method for residual household waste composition studies," Waste Management, vol.46, pp. 3–14, 2021.

[2] SM Dudhal, BS Jonwal, HP Chaudhari, "Waste Segregation Using Programmable Logic Controller," International Journal for Technological Research in Engineering, 1(8), 2021.

[3] S Zavare, R Parashare, S Patil, "Smart City waste management system using GSM," Int. J. Comput. Sci. Trends Technol, 5(3), 74-78, 2020.

[4] M. Rafeeq, Ateequrahman, S. Alam, and Mikdad, "Automation of plastic, metal and glass waste materials segregation in scrap industry," 2016 International Conference on Communication and Electronics Systems (ICCES), 2020.

[5] R Ramya, G Pooja, D Ranjitha Ramya, R., Pooja, G., Ranjitha, D., Tabassum, T. B., &Guptha, N. S, **"**Smart bins using dry and wet waste detectors," International Journal of Advanced Research in Computer Science, 9(Special Issue 3), 164, 2018.

[6] Sreejth; R. Ramya, R, Roja, A, Sanjay Kumar (2019). (IEEE 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS)-Coimbatore, India (2019.3.15 2019.3.16) 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS) - Smart Bin for Waste Management System.

[7] Ramji DR, Shinde JR, Venkateswarlu R. Smart Hands-Free Waste Compactor Bin for Public Places. International Journal of Digital Electronics. 2019;1(2):52

[8] Pankaj Vikrant Bhor1, Maheshwar Morajkar2, Dishant Gurav3, Pandya, (2017) "Smart Garbage Management System" in International Journal of Engineering Research & Technology, vol.no 4, issue 3, p. 1117 – 1119.

[9] Monika K A, Rao N, Prapulla S B and Shobha G, (2016) "Smart Dustbin-An Efficient Garbage Monitoring System" in International Journal of Engineering Science and Computing, vol.no 6, p.7113-16.

[10] Navghane S S, Killedar M S and Rohokale D V, (2016) "IoT Based Smart Garbage and Waste Collection Bin" in International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) vol.no 5, p.1576-78.