

Waste Segregate System in Water

Nomula Srinivas

Associate Professor, Department of ECE, Khammam Institute of Technology and sciences, Khammam, India

Abstract--- Rapid increase in population has led to improper waste management in metro cities and urban areas which has resulted in spreading of diseases. It is estimated that 2.02 billion tons of municipal solid waste was generated universally in 2006. The segregation, transport, handling and disposal of waste must be managed properly to minimize the risks to the public, and the environment. An efficient method to dispose the waste has been designed in our project, "automatic waste segregator and monitoring system". This paper proposes an automatic waste segregator (AWS) which is a cheap, easy to use solution for a segregation system at households, so that the wastes can be sent directly for processing. Automatic waste segregator is designed to sort the waste into three main categories namely; metallic, organic and plastic, thereby making the waste management more effective.

Keywords--- Pulse width modulation (PWM); serial port protocol (SSP), Arduino Uno (USB based Arduino)

I. INTRODUCTION

In India about 60 million tons of waste is being generated every year. Ten million tons of garbage is generated in metropolitan cities. The landfills of most of these cities are overflowing with no space for fresh garbage waste. The philosophy of "waste management hierarchy" has been adopted by most nations as the step for developing municipal solid waste (MSW) management strategies. According to a sanitation survey called "Swatch Survekshan-2016" conducted by the ministry of urban development under the Swatch Bharat mission, of improper waste it was found that about 50% people in India face the problem collection and management. According to centre of science and environment, innovative disposal and recycling methods must be introduced instead of landfill sites. Thus, we have proposed a cost effective "Automatic waste segregator and monitoring system" for proper management of waste. Automatic waste segregator categorizes the waste as plastic, metallic or organic. The monitoring system helps to monitor the waste collection process. The common method of waste disposal is by unplanned and uncontrolled dumping at landfill areas. This method is hazardous to human health, plant and animal life. When the waste is segregated into basic streams such as plastic, metallic and organic, the waste has a higher potential of recovery, and then, recycled and reused. The organic waste is converted either into compost or methane-gas or both. Compost can replace demand for chemical fertilizers, and biogas can be used as a source of energy. The metal waste could be reused or recycled. Even if there are large scale industrial waste segregators present, it is always feasible to separate the waste at the source itself. The benefit of doing

so is that the occupational hazard for waste workers is reduced. Also, the separated waste could be directly sent to the recycling and processing plant instead of sending it to the segregation plant then to the recycling plant.

Existing System

For the segregation of waste present in the earth surface there are different types of systems are present. The main aim of these segregation process is to segregate any kind of the wastage. Some of the systems in segregation process are as follow:

1. TROMMEL SEPARATOR/DRUM SCREENS: -Here a large size of wheel is used to segregate the wastage by separating the kinds of wastage.
2. EDDY CURRENT SEPERATORS: -An eddy current separator uses a powerful magnetic field to separate non-ferrous metals from waste after all ferrous metals have been removed previously by some arrangement of magnets. The device makes use of eddy currents to effect the separation.
3. INDUCTOR SORTING: -Modern, inductive metal sensors are used for metal separation in the smallest grain sizes proven technology for separating all metals.
4. MANUAL SORTING: -Waste segregation is done manually.

II. PROPOSED SYSTEM

Waste Management and segregation is a much-needed process in metro cities and urban areas due to spreading of diseases. It is estimated that India produces 42.0 million tons of municipal solid waste annually at present. Waste lying littered in the surrounding, dumped on open lands, becomes a major problem for various types of disease-causing bacteria and viruses hence, segregation, transport,

handling and disposal of waste must be managed properly to minimize the risks of the public and environment. Segregation makes it attainable to utilize and recycle the waste effectively. This waste segregator system can easily segregate waste. Arduino connected robot setup is placed in water. This setup moves over the water surface by collecting all the waste to end shore. This robot setup is controlled by Bluetooth.

BLOCK DIAGRAM

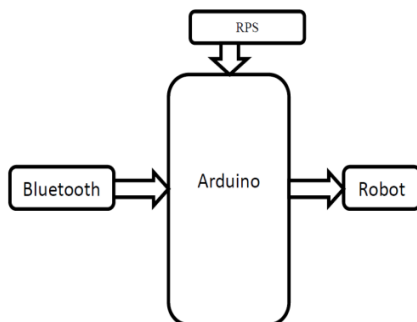


Fig. 1. Block diagram

HARDWARE COMPONENTS:

- BLUETOOTH
- ARDUINO
- L293D
- DC MOTOR

III. POWER SUPPLY:

A regulated power supply is an embedded circuit; it converts unregulated AC (Alternating Current) into a constant DC. With the help of a rectifier it converts AC supply into DC. Its function is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DC (Direct Current). The type of stabilization used may be restricted to ensuring that the output remains within certain limits under various load conditions, or it may also include compensation for variations in its own supply source. The latter is much more common today.

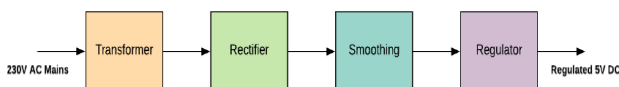


Fig. 2. Block diagram of regulated power supply

The applications of the regulated power supply include the following. A regulated power supply (RPS) is an embedded circuit, used to convert unregulated alternating current into a stable direct current by using a rectifier. The

main function of this is to supply a constant voltage to a circuit that should be functioned in a particular power supply limit.

Mobile phone chargers, Regulated power supplies in different appliances, Various oscillators & amplifiers Thus, this is all about a regulated power supply(RPS) From the above information, finally, we can conclude that an RPS changes unregulated alternating current to a stable direct current. A regulated DC power supply is also named as a linear power supply. This supply will allow an AC input as well as provides a stable DC o/p.

IV. ARDUINO

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an AT mega microcontroller — essentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip. Unlike, say, a Raspberry Pi, it's designed to attach all kinds of sensors, LEDs, small motors and speakers, servos, etc. directly to these pins, which can read in or output digital or analog voltages between 0 and 5 volts. The Arduino connects to your computer via USB, where you program it in a simple language (C/C++, similar to Java) from inside the free Arduino IDE by uploading your compiled code to the board. Once programmed, the Arduino can run with the USB link back to your computer, or stand-alone without it — no keyboard or screen needed, just power.

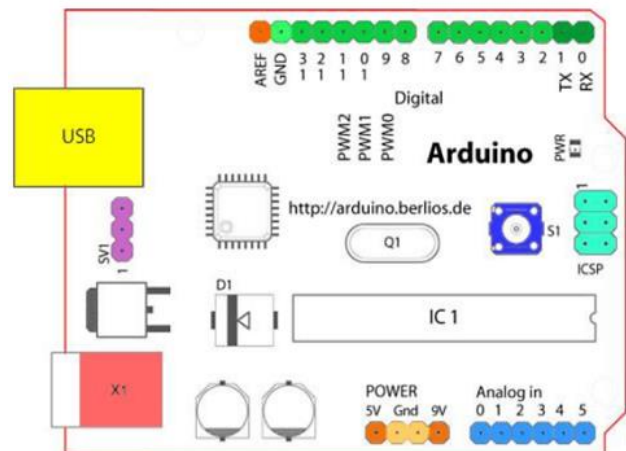


Fig. 3. Structure of Arduino Board

Looking at the board from the top down, this is an outline of what you will see

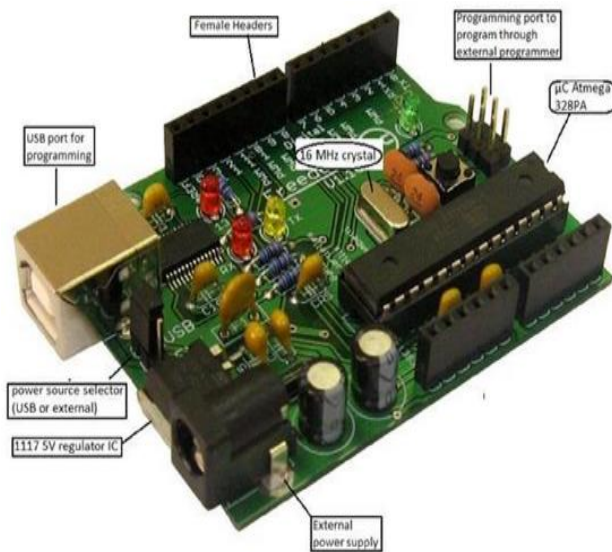


Fig. 4. Arduino Board

Starting clockwise from the top centre:

- Analog Reference pin (orange)
- Digital Ground (light green)
- Digital Pins 2-13 (green)
- Digital Pins 0-1/Serial in/Out - TX/RX (dark green) - These pins cannot be used for digital i/o (Digital Read and Digital Write) if you are also using serial communication (e.g. Serial. Begin).
- Reset Button - S1 (dark blue)
- In-circuit Serial Programmer (blue-green)
- Analog in Pins 0-5 (light blue)
- Power and Ground Pins (power: orange, grounds: light orange)
- External Power Supply in (9-12VDC) - X1 (pink)
- Toggles External Power and USB Power (place jumper on two pins closest to desired supply) - SV1 (purple)
- USB (used for uploading sketches to the board and for serial communication between the board and the computer; can be used to power the board)

Digital Pins

In addition to the specific functions listed below, the digital pins on an Arduino board can be used for general purpose input and output via the pin Mode(), Digital Read(), and Digital Write() commands. Each pin has an internal pull-up resistor which can be turned on and off using digital Write () (w/ a value of HIGH or LOW, respectively) when the pin is configured as an input. The maximum current per pin is 40mA.

- Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. On the Arduino Board, these pins are connected to the corresponding pins of the FTDI USB-to-TTL Serial chip. On the Arduino BT, they are connected to the corresponding pins of the WT11 Bluetooth module. On the Arduino Mini and Lily Pad Arduino, they are intended for use with an external TTL serial module (e.g. the Mini-USB Adapter).
- External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt function for details.
- PWM: 3, 5, 6, 9, 10, and 11 Provide 8-bit PWM output with the analog Write() function. On boards with an ATmega8, PWM output is available only on pins 9, 10, and 11.
- BT Reset: 7. (Arduino BT-only) Connected to the reset line of the Bluetooth module.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.
- LED: 13. On the Board and Lily Pad, there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

Analog Pins

In addition to the specific functions listed below, the analog input pins support 10-bit analog-to-digital conversion (ADC) using the analog Read() function. Most of the analog inputs can also be used as digital pins: analog input 0 as digital pin 14 through analog input 5 as digital pin 19. Analog inputs 6 and 7 (present on the Mini and BT) cannot be used as digital pins.

- I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library (documentation on the Wiring website).

Power Pins

- VIN (sometimes labeled "9V"): The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin. Also note that the Lily Pad has no VIN pin and accepts only a regulated input.
- 5V: The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board

regulator, or be supplied by USB or another regulated 5V supply.

- 3V3 (Board-only): A 3.3-volt supply generated by the on-board FTDI chip.
- GND: Ground pins.

Other Pins

- AREF: Reference voltage for the analog inputs. Used with analog Reference().
- Reset: (Board-only) Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board

Atmega328

Pin diagram

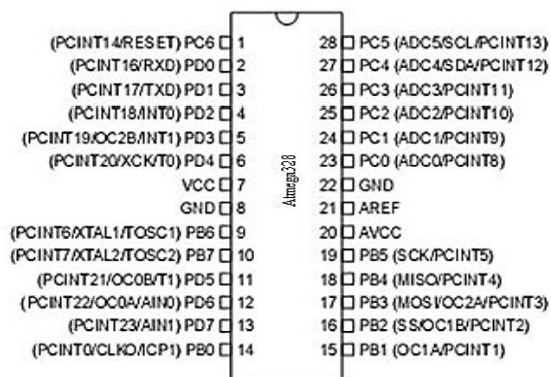


Fig. 5. Pin Configuration of Atmega328

Pin Description

VCC: Digital supply voltage.

GND: Ground.

Port A (PA7-PA0): - Port A serves as the analog inputs to the A/D Converter. Port A also serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tri-stated when a reset condition becomes active, even if the clock is not running.

Port B (PB7-PB0): -Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port B also serves

the functions of various special features of the ATmega32. **Port C (PC7-PC0):** -Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. The TD0 pin is tri-stated unless TAP states that shift out data are entered. Port C also serves the functions of the JTAG interface.

Port D (PD7-PD0): - Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega32.

Reset (Reset Input): -A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. Shorter pulses are not guaranteed to generate a reset.

XTAL1: -Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

XTAL2: -Output from the inverting Oscillator amplifier.

VCC: -VCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

REF: -REF is the analog reference pin for the A/D Converter.

Features

- 1.8-5.5V operating range
- Up to 20MHz
- Part: ATMEGA328P-AU
- 32kB Flash program memory
- 1kB EEPROM
- 2kB Internal SRAM
- 2 8-bit Timer/Counters
- 16-bit Timer/Counter
- RTC with separate oscillator
- 6 PWM Channels
- 8 Channel 10-bit ADC
- Serial USART
- Master/Slave SPI interface
- 2-wire (I2C) interface

- Watchdog timer
- Analog comparator
- 23 IO lines
- Data retention: 20 years at 85C/ 100 years at 25C
- Digital I/O Pins are 14 (out of which 6 provide PWM output)
- Analog Input Pins are 6.
- DC Current per I/O is 40 mA
- DC Current for 3.3V Pin is 50mA

AVR CPU Core

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

Overview

This section discusses the AVR core architecture in general. The main function of the CPU core is to ensure correct program execution. The CPU must therefore be able to access memories, perform calculations, control peripherals, and handle Interrupts.

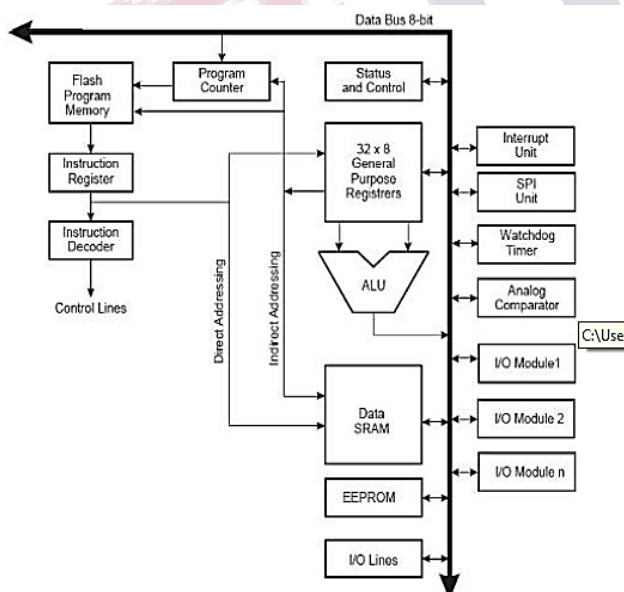


Fig. 6. AVR core architecture

In order to maximize performance and parallelism, the AVR uses Harvard architecture – with separate memories and buses for program and data. Instructions in the program memory are executed with a single level

pipelining. While one instruction is being executed, the next instruction is pre-fetched from the program memory. This concept enables instructions to be executed in every clock cycle. The program memory is In-System Reprogrammable Flash memory. The fast-access Register File contains 32 x 8-bit general purpose working registers with a single clock cycle access time. This allows single-cycle Arithmetic Logic Unit (ALU) operation. In a typical ALU operation, two operands are output from the Register File, the operation is executed, and the result is stored back in the Register File– in one clock cycle. Six of the 32 registers can be used as three 16-bit indirect address register pointers for Data Space addressing – enabling efficient address calculations. One of these address pointers can also be used as an address pointer for look up tables in Flash program memory. These added function registers are the 16-bit X-, Y-, and Z-register, described later in this section. The ALU supports arithmetic and logic operations between registers or between a constant and a register. Single register operations can also be executed in the ALU. After an arithmetic operation, the Status Register is updated to reflect information about the result of the operation. Program flow is provided by conditional and unconditional jump and call instructions, able to directly address the whole address space. Most AVR instructions have a single 16-bit word format. Every program memory address contains a 16- or 32-bit instruction. Program Flash memory space is divided in two sections, the Boot Program section and the Application Program section. Both sections have dedicated Lock bits for write and read/write protection. The SPM instruction that writes into the Application Flash memory section must reside in the Boot Program section. During interrupts and subroutine calls, the return address Program Counter (PC) is stored on the Stack. The Stack is effectively allocated in the general data SRAM, and consequently the Stack size is only limited by the total SRAM size and the usage of the SRAM. All user programs must initialize the SP in the Reset routine (before subroutines or interrupts are executed). The Stack Pointer (SP) is read/write accessible in the I/O space. The data SRAM can easily be accessed through the five different addressing modes supported in the AVR architecture. The Emory spaces in the AVR architecture are all linear and regular memory maps. A flexible interrupt module has its control registers in the I/O space with an additional Global Interrupt Enable bit in the Status Register. All interrupts have a separate Interrupt Vector in the Interrupt Vector table. The interrupts have priority in accordance with their Interrupt Vector position. The lower the Interrupt Vector address, the higher the priority.

Arduino with ATmega328

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to versionR2) programmed as a USB-to-serial converter.

- Pin out: Added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino. Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.
- Stronger RESET circuit.
- AT mega 16U2 replace the 8U2.
- "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform; for a comparison with previous versions, see the index of Arduino board

PWM controllers

Many microcontrollers include on-chip PWM controllers. For example, Microchip's PIC16C67 admits two, each other which has a selectable on-time and period of time. The duty cycle is the ratio of the on-time to the period; the modulating frequency is the inverse of the period. To start PWM procedure, the data sheet suggests the software should:

- Set the period of time in the on-chip timer/counter that provides the modulating square wave
- Set the on-time in the PWM assure register
- Set the direction of the PWM output, which is one of the general-function I/O pins
- Start the timer
- Enable the PWM controller

Although particular PWM controllers do vary in their programmatic details, the basic idea is generally the same.

D.C. Motor:

A dc motor uses electrical energy to produce mechanical

energy, very generally through the interaction of magnetic fields and current-containing conductors. The reverse process, producing electrical energy from mechanical energy, is carried out by an alternator, source or dynamo. Many types of electric motors can be run as sources, and vice versa. The input of a DC motor is current/voltage and its output is torque (speed).



Fig. 6. AVR DC Motor

The DC motor has two basic parts: the rotating part that is called the armature and the stable part that includes coils of wire called the field coils. The stationary part is also called up the stator. Figure shows a depict of a distinctive DC motor, Figure shows a picture of a DC armature, and Figure shows a picture of a distinctive stator. From the picture you can see the armature is made of coils of wire wrapped around the core, and the core has a covered shaft that rotates on charges. You should also notice that the ends of each coil of wire on the armature are finished at one end of the armature. The outcome points are called the commutator, and this is where's brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

DC Motor Driver:

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to allow for bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is planned to provide bidirectional drive currents of up to 600-mA at voltages of 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar maltreating motors, as well as other high-current/high up-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor drop and a pseudo-Darlington source. Drivers are changed in pairs, with drivers 1 and 2 enabled near 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the linked drivers are enabled and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled and their outputs are off and in the high-impedance state. With the thoroughly data inputs,

each pair of drivers forms a Full-H (or bridge) reversible drive suitable for solenoid or motor applications. On the L293, international high-speed output clamp diodes should be used for inductive transient stifling. A VCC1 terminal, classify from VCC2, is provided for the logic inputs to minimize device power dissolution. The L293 and L293D are characterized for operation from 0°C to 70°C.



Fig7. L293D IC

HC-05 Bluetooth module

Data from other Bluetooth devices and the other is the AT Command mode where the default device settings can be changed. We can operate the device in either of these two modes by using the key pin as explained in the pin description.

It is very easy to pair the HC-05 module with microcontrollers because it operates using the Serial Port Protocol (SPP). Simply power the module with +5V and connect the Rx pin of the module to the TX of MCU and TX pin of module to Rx of MCU as shown in the figure below

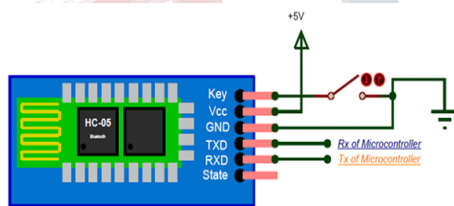


Fig7. HC-05

During power up the key pin can be grounded to enter into Command mode, if left free it will by default enter into the data mode. As soon as the module is powered you should be able to discover the Bluetooth device as “HC-05” then connect with it using the default password 1234 and start communicating with it.

2D Model

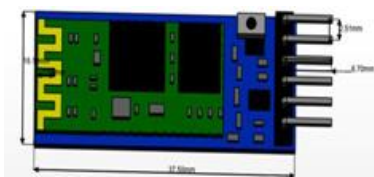


Fig8. 2D model of HC_05 Module

V. RESULTS

This process helps a lot in process of cleaning of water. The setup used for segregation process is shown below:



Fig 9 System of segregation process

This setup is controlled by using a Bluetooth module. The controlling unit is shown below:



Fig 10. Controlling unit

ROBOT setup floats on the water surface with help of wheels. They are shown below:

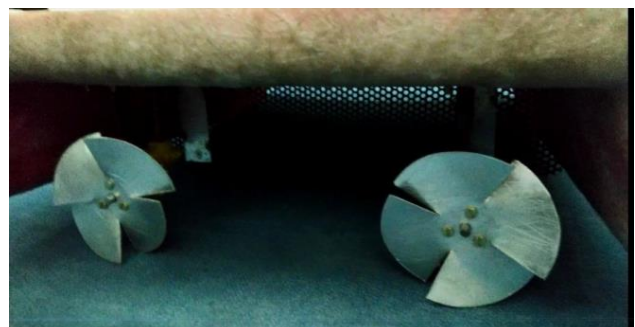


Fig 10. Wheels of the system

VI. CONCLUSION

The waste segregator as the name suggests, segregates the waste into three major classes: plastic, organic, metallic.

The proposed system would be able to monitor the solid waste collection process and management of the overall collection process. The inlet section is provided with open and close mechanism to regulate the flow of waste on to the conveyor. Inductive proximity sensor is used to detect the metallic waste. A blower mechanism is used to segregate dry and wet waste. The timing and movement of the conveyor belt is controlled by Arduino Uno. Continuous and unnecessary operation of any particular section is thus avoided.

REFERENCES

- [1] Bajaj JS. Urban Solid Waste Management in India. New Delhi: Planning Commission Government of India; 1995.
- [2] Daniel Hoornweg, et al. What a Waste: A Global Review of Solid Waste Management. Washington, DC: Urban Development & Local Government Unit World Bank, No.15; Mar 2012.
- [3] Shushi Gupta, Krishna Mohan, Raj Kumar Prasad, et al. Solid Waste Management in India: Options and Opportunities. In Resource, Conservation and Opportunities. Nov 1996; 24(2): 137p.
- [4] Pushpa MK, et al. Microcontroller Based Automatic Waste Segregator. International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering (IJIREEICE). May 2015; 3(5).
- [5] Nishigandha Kothari. Waste to Wealth. New Delhi: NSWAI; Jul 2013.
- [6] Sakai S, Sewell SE, Chandler AJ. World Trends in Municipal Solid Waste Management. Environmental Preservation Centre, Kyoto University, Japan. 1996; 16: 341p.
- [7] Claudine Capel. Innovations in Waste. Waste Management World. Mar 2010; 11(2).
- [8] Claudine Capel. Waste Sorting: A Look at the Separation and Sorting Techniques in Today's European Market. Waste-Management-World. Jul 2008; 9(4).
- [9] Satish M, et al. E-bin. Advance in Electronic and Electric Engineering (AEEE). 2013; 3.
- [10] Amrita Chandra Mohan, et al. Automated Waste Segregator. National Level Analog System Design Contest, 2013–2014; Conducted by Texas Instruments, India
- [11] Yamazaki S, Nakase GH, Tanaka A. Basic Analysis of a Metal Detector. IEEE Instar Meas. Aug 2002; 51(4): 810–814p.
- [12] Carlo A, Purvis M. An Ultrasonic Sensor for Distance Measurement in Automotive Applications. In: IEEE Sensors J. 1(2):143p.
- [13] Vicentini F, Giusti A, Rovetta A, et al. Sensor zed Waste Collection Container for Content Estimation and Collection Optimization. Waste Manage. 2008; 29: 1467–1472p.
- [14] Maher Arebey, Hannah MA, Hassan Basri, et al. Overview for Solid Waste Bin Monitoring and Collection System.