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Innovation Challenge

Competition

IoT Based Waste Management Catering Conversion of Bio-Degradable Debris Into Organic Manure

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CHAPTER 1

INTRODUCTION

Internet of Things (IoT) is a new revolution of the Internet. It makes objects themselves recognizable, obtain intelligence, communicate information about themselves and they can access information that has been aggregated by other things. The Internet of Things allows people and things to be connected anytime, anyplace, with anything and anyone, ideally using any path/network and any service as shown in Fig. 1. This implies addressing elements such as Convergence, Content, Collections, Computing, Communication and Connectivity.

The Internet of Things provides interaction among the real/physical and the digital/virtual worlds. The physical entities have digital counterparts and virtual representation and things become context aware and they can sense, communicate, interact, exchange data, information and knowledge. Through the use of intelligent decision- making algorithms in software applications, appropriate rapid responses can be given to physical entity based on the very latest information collected about physical entities and consideration of patterns in the historical data, either for the same entity or for similar entities. These paves new dimension of IoT concept in the domains such as supply chain management, transportation and logistics, aerospace and automotive, smart environments (homes, buildings, infrastructure), energy, defence, agriculture, retail and more.

The vision of IoT is to use smart technologies to connect things any-time, any-place *for anything.* The IoT was started in the year 1998 and the term *Internet of Things* was first coined by Kevin Ashton in1999.

Figure-1.1 Overview of Internet of Things

The IoT has been evolved in a tremendous way over the past decade and still it is an emerging trend for researchers in both academia and industry. Many findings of IoT reported in literature presents meaningful definitions. According to CASAGRAS project : "A global network infrastructure linking physical and virtual objects through the exploitation of data capture and communication capabilities. This infrastructure includes existing and evolving Internet and network developments. It offers specific object identification, sensor and connection capability as the basis for the development of independent cooperative services and applications. CERP emphasizes theinternet working between heterogeneous 'smart' devices such as sensors, actuators, computers and smart phones etc., and the use of services over the internet. Any application development framework for the IoT, therefore, needs to support these heterogeneousdevices.

According to the IEEE Internet of Thingsjournal, An IoT system is a network of networks where, typically, a massive number of objects/things/sensors/devices are connected through communications and information infrastructure to provide value-added services via intelligent data processing and management for different applications. The IoT is a computing concept that describes a future where everyday physical objects can be connected to the Internet and will be able to identify themselves to other devices. The term is closely identified with RFID as the method of communication, although it could also include other sensor technologies, other wireless technologies, QR codes, etc. According to The IoT European Research Cluster (IERC) definition states that IoT is a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" haveidentities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network.

1.1KEY FEATURES

The most important features of IoT include artificial intelligence, connectivity, sensors, active engagement, and small device use. A brief review of these features is given below:

1.1.1 AI–IoTessentiallymakesvirtuallyanything“smart”,meaningitenhanceseveryaspect of life with the power of data collection, artificial intelligence algorithms, and networks. Thiscanmeansomethingassimpleasenhancingyourrefrigeratorandcabinetstodetect whenmilkandyourfavouritecerealrunlowandtothenplaceanorderwithyourpreferred grocer.

1.1.2 Connectivity – New enabling technologies for networking and specifically IoT is no longer exclusively tied to major providers. Networks can exist on a much smaller and cheaper scale while still being practical. IoT creates these small networks between its systemdevices.

1.1.3 Sensors – IoT loses its distinction without sensors. They act as defining instruments which transform IoT from a standard passive network of devices into an active system capable of real-worldintegration.

1.1.4 Active Engagement – Much of today's interaction with connected technology happens throughpassiveengagement.IoTintroducesanewparadigmforactivecontent,product, or serviceengagement.

1.1.5 Small Devices – Devices, as predicted, have become smaller, cheaper, and more powerful over time. IoT exploits purpose-built small devices to deliver its precision, scalability, andversatility.

1.2APPLICATION DOMAIN

The Applications of the IoT are numerous and diversified in all areas of every-day life of people which broadly covers society, industries, and environment. All the IoT applications developed so far comes under these three broad areas. According to Internet of Things Strategic Research Agenda (SRA) during 2010, six or more application domains were identified that are smart energy, smart health, smart buildings, smart transport, smart living and smart cities. A survey about the IoT-I project 65, IoT application scenarios have been identified and grouped in to 14 domains, which are Transportation, Smart Home, Smart City, Lifestyle, Retail, Agriculture, Smart Factory, Supply chain, Emergency, Health care, User interaction, Culture and tourism, Environment and Energy. Some of the IoT applications are briefly explained in next comingparagraphs.

Domain	Description	Applications
Society	Activities related to the betterment and development of society, cities and people	Smart Cities, Smart Animal, Farming, Smart Agriculture, Healthcare, Domestic and Home automation, Independent Enerdy, Defense, Medical technology, Ticketing, Smart Buildings.
Environment	Activities related to the protection, monitoring and development of all natural resources	Smart Environment, Smart Metering, Smart Water Recycling, Disaster Alerting
Industry	Activities related tofinancial,transactions organizations and other entities.	Retail, Logistics, Supply Chain Management Automotive, Control and Aerospace Aviation

Table 1.1 IoT Application Domains

1.2.1 SMARTCITIES

The IoT play a vital role to improve the smartness of cities including many applications like monitoring of parking spaces availability in the city, monitoring of vibrations and material conditions in buildings and bridges, sound monitoring in sensitive areas of cities, monitoring of vehicles and pedestrian levels, intelligent and weather adaptive lighting in street lights, detection ofwaste containers levels and trash collections, smart roads, intelligent highways with warning messages and diversions according to climate conditions and unexpected events like accidents or traffic jams. Some of IoT smart cities applications are smart parking, structural health, noise urban maps, traffic congestion, smart lightning, waste management, intelligent transportation systems and smart building. These smart cities IoT applications use

RFID, Wireless Sensor Network and Single sensors as IoT elements and the bandwidth of these applications ranges from small to large. The existing IoT applications reported on the literature are Awarehome, Smart Santander and city sense.

1.2.2 SMART AGRICULTURE AND SMARTWATER

The IoT can help to improve and strengthen the agriculture work by monitoring soil moisture and trunk diameter in vineyards to control and maintain the amount of vitamins in agricultural products, control micro climate conditions to maximize the production of fruits and vegetables and its quality, study of weather conditions in fields to forecast ice information, rail, drought, snow or wind changes, control of humidity and temperature level to prevent fungus and other microbial contaminants. The role of IoT in water management includes study of water suitability in rivers and the sea for agriculture and drinkable use, detection of liquid presence outside tanks and pressure variations along pipes and monitoring of water level variations in rivers, dams and reservoirs. This kind of IoT applications use Wireless sensor network and single sensors as IoT elements and the bandwidth range as medium. The already reported IoT applications in this kind are SiSviA, GBROOS andSEMAT.

1.2.3 RETAIL AND LOGISTICS

Implementing the IoT in Retail/Supply Chain Management has many advantages which include monitoring of storage conditions along the supply chain and product tracking for traceability purposes and payment processing based on location or activity duration for public transport, gyms, theme park, etc. In the shop itself, IoT offers many applications like guidance in the shop according to a preselected shopping list, fast payment solutions like automatically check-out using biometrics, detection of potential allergen in a given product and control of rotation of products in shelves and warehouses to automate restocking processes. The IoT elements used in this kind of application are RFID and WSN and the bandwidth range is small. The example retail IoT reported in literature is SAP future retail center [10]. The IoT in logistics includes quality of shipment conditions, item location, storage incompatibility detection, fleet tracking, etc. The IoT elements used in the field of logistics are RFID, WSN and single sensors and the bandwidth ranges from medium to large.

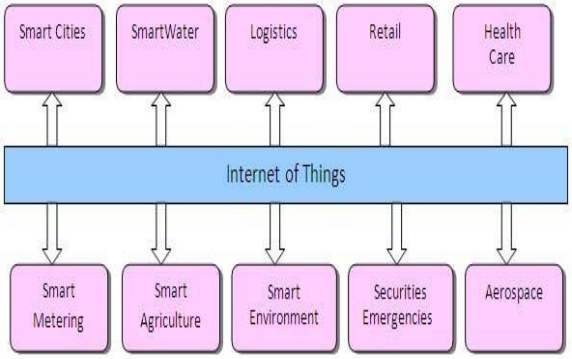


Figure-1.2 Internet of Thing

1.2.4 HEALTH CARE

Many benefits provided by the IoT technologies to the healthcare domain are classified into tracking of objects, staff and patients, identification and authentication of people, automatic data collection and sensing. Tracking is the function used to identify a person or an object in motion. This includes the case of patient flow monitoring to improve workflow in hospitals. The identification and authentication includes patient identification to reduce incidents harmful to patients, comprehensive and current electronic medical record maintenance, and infant identification in hospitals to prevent mismatching. The automatic data collection and transfer is mostly aimed at reducing form processing time, process automation, automated care and procedure auditing, and medical inventory management. Sensor devices enable function centered on patients, and in particular on diagnosing patient conditions, providing real-time information on patient health indicators.

1.2.5 SECURITY &EMERGENCIES

The IoT technologies in the field of security and emergencies are tremendously increased in which few are listed access control, liquid presence, radiation levels and explosive and hazardous gases, etc. The perimeter access control is used to detect and control unauthorized people entry to restricted areas. The liquid presence is used for liquid detection in data centers, warehouses and sensitive building grounds to prevent break downs and corrosion. The radiation levels application used to measure the radiation levels in nuclear power stations surroundings to generate leakage alerts andfinal IoT application is used to detect the gas levels and leakages in industrial environments, surroundings of chemical factories and insidemines.

CHAPTER 2

LITERATURE REVIEW

This chapter deals with all the main sequences of model along with the background study and related works.

2.1 MANAGING WASTE THROUGH THE INTERNET OF THINGS

Waste management has become a topical issue in various parts of the world. Conceptually, there is confusion between waste management and garbage collection in some countries. Waste management includes various steps such as prevention, collection (with separation of various forms of waste), recycling, reuse, and disposal of toxic waste. An examination of current literature shows the most waste management models are fragmented. Hence, this paper advocates dynamic and integrative models which would amount to transforming trash into cash by addition value to waste. The concept of the Internet of Things (IoT) and corollary concepts such as smart cities, invites for technology enhanced waste management systems and in the current state of knowledge, a mobile app that local municipalities can use for waste management purposes can be developed.

2.2 IoT BASED SMART GARBAGE ALERT SYSTEM USING NODE MCU

The ultimate need of the hour for a developing nation is the key for “Smart City”. The influential ecological factors that pose to be a threat to this may include: hazardous pollution and its subsequent effects on health of humanity, alarming global warming and depletion of ozone layer etc. Mostly Environmental pollution may be owing to the Municipal Solid Leftovers (MSL). A Proper maintenance becomes mandatory for an efficient and effective removal of the generated Municipal Solid Leftover. It is perceived that often the waste space gets too much occupied due to irregular removal of garbage occupancy in the dustbin. This exposition proposes an e-monitoring system that putforths an embedded system and web based software assimilated with RFID and IoT technology. Using the anticipated system, monitoring of the waste collection status could be monitored effectively. This design designates a technique in which the garbage level could be checked at regular intervals which

would prevent the undesirable overflow of the bin. In addition to this it also has facilitation sto intimate the authority to clean up in case of any overflows. The filling level of the garbage in the dustbin and its original level height could be sensed/ monitored by the ultrasonic sensor. Programming in the NODE MCU is done in such a way that once a particular level of filling is sensed information message is sent requesting a clean-up. Surveillance systems can be used as an assistive technology for high Quality of Service (QoS) in waste collection. Specifically, IoT components: (i) RFIDs, (ii) sensors, (iii) cameras , surveillance systems for efficient waste collection. The system incorporates a model for data sharing between truck drivers on real time in order to perform waste collection . The system handles the case of ineffective waste collection in inaccessible areas within the Smart City. Surveillance cameras are incorporated for capturing the problematic areas and provide evidence to the authorities. The waste collection system aims to provide high quality of service to the citizens of a Smart City.

Several solutions for waste management equipped with IoT facilities have been proposed and invented in the literature to help solid waste management authorities improve the quality of service delivery.

2.3 IOT BASED SMART GARBAGE AND WASTE COLLECTION

Many times,the garbage bins or dustbins placed at public places are overloaded. It creates unhygienic conditions for people as well as ugliness to that place leaving bad smell. To avoid all such situations we are going to implement a project called IoT Based Smart Garbage and Waste Collection bins. These dustbins are interfaced with microcontroller based system having IR wireless systems along with central system showing current status of garbage, on mobile web browser with html page by Wi-Fi. Hence the status is updated on to the html page. Major part of our project depends upon the working of the Wi-Fi module; essential for its implementation. The main aim of this project is to reduce human resources and efforts along with the enhancement of a smart city vision.

2.4 MUNICIPAL SOLID WASTE MANAGEMENT IN INDIA: A REVIEW AND SOME NEW RESULTS

Municipal solid waste (MSW) is one of the major areas of concern all over the world. In developing country like India, there is rapid increase in municipal solid waste due to

urbanization and population growth. Composition of waste varies with different factors like living standard, climatic condition, socio-economic factor etc. This report gives current scenario of India with respect to municipal solid waste quantity, quality and its management. We have presented a brief overview of MSWM in Major cities medium scale towns and small-scale towns.

2.5 SOLID WASTE MONITORING SYSTEM INTEGRATION BASED ON RFID, GPRS

The integration of communication technologies such as radio frequency identification (RFID), general packet radio system (GPRS), are constructed for solid waste monitoring system. The aim is to improve the way of responding to customer's inquiry and emergency cases and estimate the solid waste amount without any involvement of the truck driver. The proposed system consists of RFID tag mounted on the bin, RFID reader as truck module, GPSR/GSM as web-server,database server and control station server. The tracking devices mounted in the trucks collect location information in real-time via the GPRS. This information is transferred continuously through GPRS to a central database. The users are able to view the current location of each truck in the collection stage via a web-based application, and thereby manage the fleet. Thus, the solid waste of the bin are being monitored using the developed system

2.6 SMART BIN: INTERNET-OF-THINGS GARBAGE MONITORING SYSTEM

This work introduces the design and development of smart green environment of garbage monitoring system by measuring the garbage level in real time and to alert the municipality where never the bin is full based on the types of garbage. The proposed system consisted the ultrasonic sensors which measure the garbage level, an ARM microcontroller which controls system operation whereas everything will be connected. This work demonstrates a system that allows the waste management to monitor based on the level of the garbage depth inside the dustbin. The system shows the status of different types of garbage; domestic waste, paper, glass and plastic through in a real time to store the data for future use and analysis, such as prediction of peak level of garbage bin fullness. It is expected that this system can create

greener environment by monitoring and controlling the collection of garbage smartly through IoT.

2.7 HETEROGENEOUS TRASH SEGREGATION MACHINE USING IoT - A SMART WASTE MANAGEMENT SURVEY

Intelligence solid waste bin is essential to develop an efficient and dynamic waste management system. The common litter bins placed by the municipal corporation are leading no. of health, environmental and social issues. This research presents the implementation and execution of an integrated sensing system and algorithm for solid waste trash bins to automate the waste management process. Various causes like improper dustbins placement in City Corporation and specifically, people are not aware enough to use dustbins in a proper way. Such major causes are leading serious problems like an unhygienic condition, air pollution, and unhealthy environment. Several sensing methods have been integrated and have combined their verdicts that offer the detection of bin condition and its parameter measurement. Research has been carried out by developing the software application for indicating dustbins status, shortest path method for collecting vehicles by integrating Radio-Frequency Identification (RFID), Global System for Mobile communications (GSM), trash collection and management in residential locality is the basic considerations referred to in smart cities. The concept of trash collection is quite tedious. For efficient trash collection, we use the concept of the Internet of Things (IoT) which acts as a backbone technology. With the increase in population, especially in the urban areas waste collection, categorization and disposal have become a major problem for government authorities. An IoT based waste collection framework is proposed to automate the solid waste identification, localization and collection process. The optimization algorithm is used as proposed evaluation criteria to achieve higher efficiency with the outcome of the efficient and intelligent sensing system to automate any solid waste bin management process and also the goal of making cities smarter, greener to provide the healthy and hygienic environment

CHAPTER 3

EXPERIMENTAL SETUP

The hardware utilized in IoT systems includes devices for a remote dashboard, devices for control, servers, a routing or bridge device, and sensors. These devices manage key tasks and functions such as system activation, action specifications, security, communication, and detection to support-specie goals and actions.

3.1 IOT HARDWARE

When a sensor forms part of a sensor network, it is known as a sensor "NODE". While it is now easy to deploy single sensors, ensuring connectivity between multiple NODEs is a more challenging task. Sensor NODEs can be connected to each other in two ways: wire and wireless. A sensor NODE in a wireless sensor network is a small low- power device with power-supply, data storage, microprocessors, low-power radio, analogue-to-digital converters (ADCs), data transceivers, and controllers. Wireless sensor networks offer solutions for a number of sectors, such as health care, security, and agriculture.

3.1.1 NODEMCU (ESP8266 WIFI PROGRAMMING & DEVELOPMENT KIT)

NODEMCU is an open source development board and firmware based in the widely used ESP8266 -12E WiFi module. It allows you to program the ESP8266 WiFi module with the simple and powerful LUA programming language or Arduino IDE.

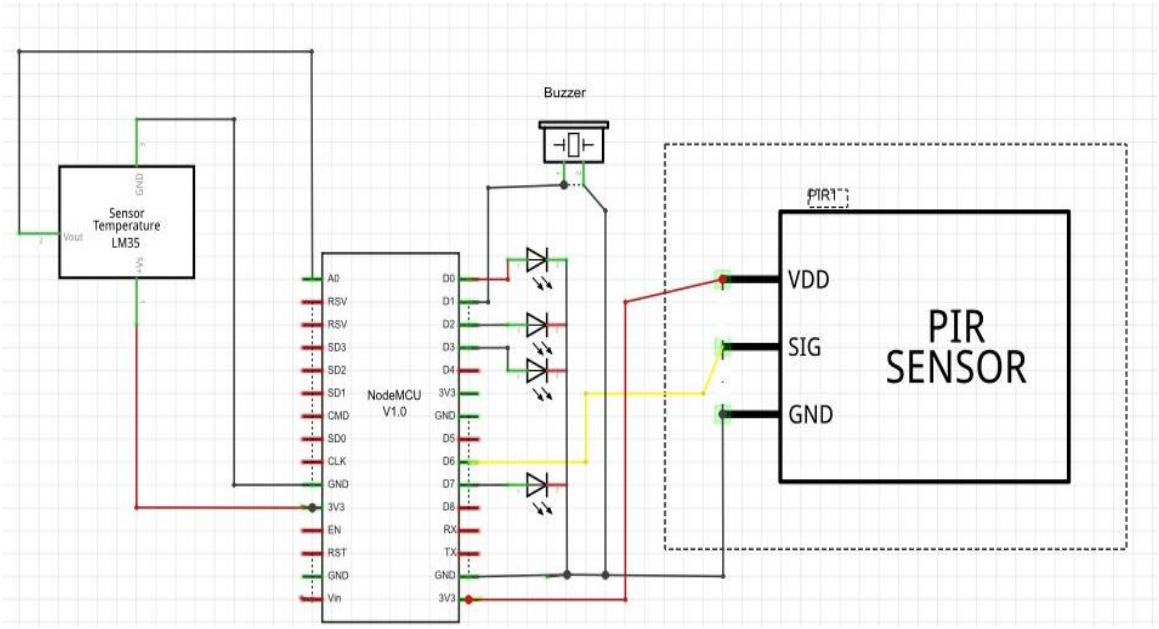
With its USB-TTL , the NODE MCU Dev board supports directly flashing from USB port. It combines features of WIFI accesspoint and station + microcontroller. These features make the NODE MCU extremly powerful tool for Wifi networking. It can be used as access point and/or station, host a webserver or connect to internet to fetch or upload data.

Features of NODEMCU

- Finally, programable Wi-Fi module.
- Arduino-like (software defined) hardware IO.
- Can be programmed with the simple and powerful Lua programming language or Arduino IDE.
- USB-TTL included, plug & play.
- 10 GPIOs D0-D10, PWM functionality, IIC and SPI communication, 1-Wire and ADC

A0 etc. all in one board.

- Wifi networking (can be used as access point and/or station, host a web server), connect to internet to fetch or upload data.
- Event-driven API for network applications.
- PCB antenna.



3.1.2 IoT Software

IoT software addresses its key areas of networking and action through platforms, embedded systems, partner systems, and middleware. These individual and master applications are responsible for data collection, device integration, real-time analytics, and application and processextensionwithintheIoTnetwork.Theyexploitintegrationwithcriticalbusinesssystems (e.g., ordering systems, robotics, scheduling, and more) in the execution of relatedtasks.

3.2DEVICE INTEGRATION

Softwaresupportingintegrationbinds(dependentrelationships)allsystemdevicestocreatethe body of the IoT system. It ensures the necessary cooperation and stable networking between devices. These applications are the defining software technology of the IoT network because

without them, it is not an IoT system. They manage the various applications, protocols, and limitations of each device to allowcommunication.

3.3REAL-TIME ANALYTICS

These applications take data or input from various devices and convert it into viable actions or clear patterns for human analysis. They analyze information based on various settings and designs in order to perform automation-related tasks or provide the data required by industry.

3.4APPLICATION AND PROCESS EXTENSION

These applications extend the reach of existing systems and software to allow a wider, more effectivesystem.Theyintegratepredefineddevicesforspecificpurposessuchasallowingcertain mobile devices or engineering instruments access. It supports improved productivity and more accurate datacollection.

CHAPTER 4

SYSTEM ANALYSIS AND DESIGN

4.1 ULTRASONIC SENSOR HC - SR04 A

4.1.1 WORKING PRINCIPLE

Ultrasonic ranging module HC - SR04 offers a 2cm - 400cm non-contact measurement function, the ranging accuracy could reach up to 3mm. The building modules includes ultrasonic transmitters, receiver and control circuit.

The basic principle:

(1) Making use of IO trigger for at least 10us high level signal,

(2) The Unit inevitably sends eight 40 kHz and detects whether there is any pulse signal back.

(3) If any of a signal is received back in a high level, time of high output IO duration is the time from sending ultrasonic signal and receiving it back.

Test distance = (high level time× velocity of sound (340M/S) / 2

4.1.2 OPERATION

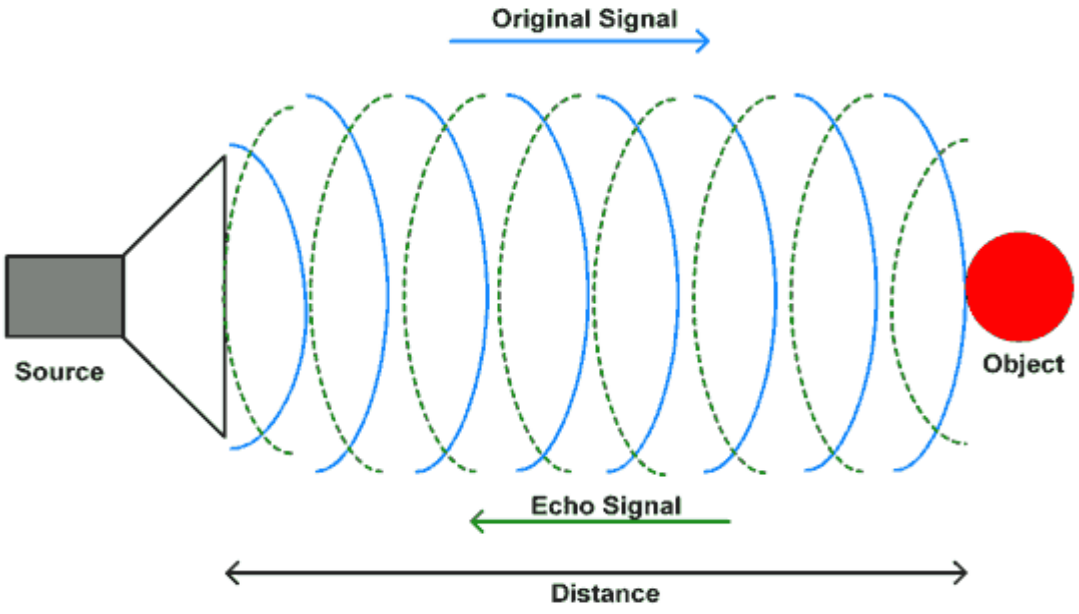


Figure 4.1 Working principle of ultrasonic sensor

Here electrical energy is transformed into sound to send the pulse. The sound that is received back is converted into electricity. Thus the time lag between the sent and received sound signal is used to estimate the distance to the object. Spacing between sensors is dogged by their beam angles. The sensors must be spaced so that they do not interfere with each other. This interference is sometimes referred to as “crosstalk”. The target should be mounted perpendicular to the axis of the sensor.

4.2 PIR SENSOR

PIR sensor detects a human being moving around within approximately 10m from the sensor. This is an average value, as the actual detection range is between 5m and 12m.PIR are fundamentally made of a pyro electric sensor, which can detect levels of infrared radiation. For numerous essential projects or items that need to discover when an individual has left or entered the area. PIR sensors are incredible, they are flat control and minimal effort, have a wide lens range, and are simple to interface width.

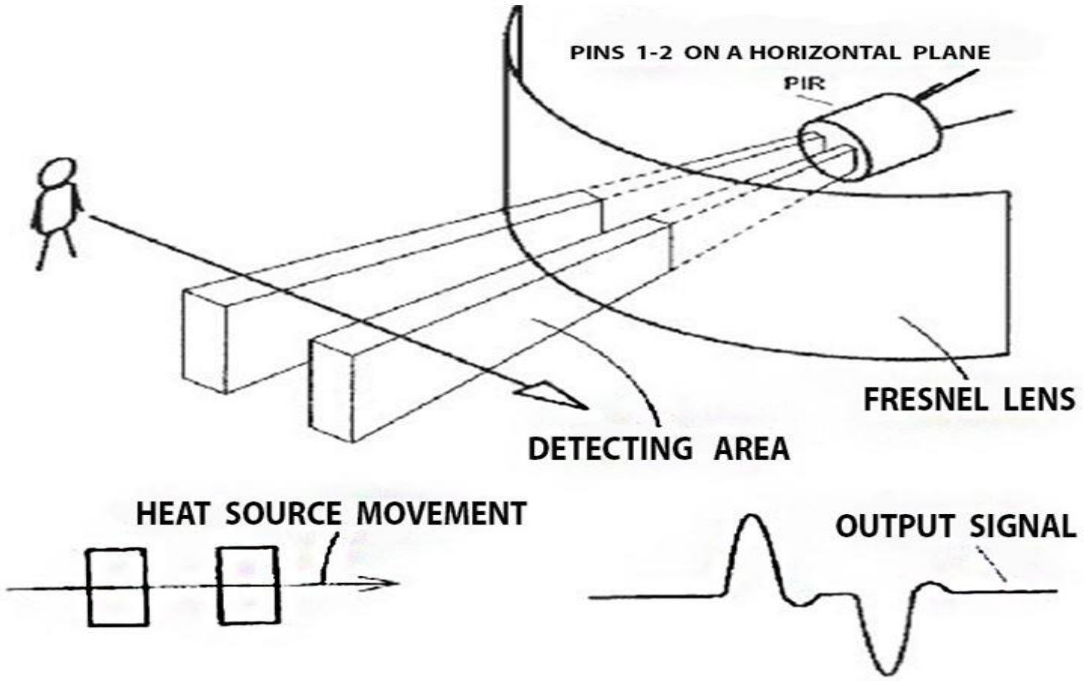


Figure-4.2 Working principle of PIR Sensor

Most PIR sensors have a 3-pin connection at the side or bottom. One pin will be ground, another will be signal and the last pin will be power. Power is usually up to 5V. Sometimes bigger modules don't have direct output and instead just operate a relay which case there is ground, power and the two switch associations. Interfacing PIR with microcontroller is very easy and simple. The PIR acts as a digital output so all you need to do is listening for the pin to flip high or low. The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up the output will remain low until there is motion, at which time the output will swing high for a couple of seconds, then return low. If motion continues the output will cycle in this manner until the sensors line of sight of still again. The PIR sensor needs a warm-up time with a specific end goal to capacity fittingly. This is because of the settling time included in studying nature's domain. This could be anyplace from 10-60 seconds.

4.3 CAPACITIVE SENSOR

Capacitive sensing is a growing technology to replaceoptical detection methods and mechanical designs forapplications namely proximity /gesture detection,material analysis and liquid level sensing and some otherapplications. One of the main advantage of capacitivesensing, and the one we are concentrating on in our paperproposal, is the use of it in sensing different kind ofmaterials (plastic, liquid, metal etc.). It has the ability tosense up to a larger distance with greater accuracy. Thesensor is cost-efficient and has a low power consumptionwhich is an added advantage to meet the powerconstraints. FDC1004 is a capacitive sensormanufactured by Texas Instruments.

Capacitance is the ability of a capacitor to store electriccharge. A parallel plate capacitor is widely used and itscapacitance is calculated by C=Q/V where C is thecapacitance of the charge stored at a voltage V [2].

Theparallel plate capacitor consists of twoconductor plates and the capacitance is calculated by:C= (Ɛ r*Ɛ o*A)/d (1)

Equation 1 is characterised by:

- A is the area of the two plates
- Ɛ r is the relative dielectric constant of thematerial between the plates.
- Ɛ o is the absolute permittivity of free space(8.854 x 10-12 F/m)

Type of waste	**Waste Object**
Dry Waste or Non bio degradable waste	Paper
	Plastic bag
	Plastic box
	Plastic lid
	Dry cloth
Wet waste or Bio degradable waste	Onion
	Banana peel
	Potato peel
	Carrot peel
	Other vegetable materials

Table 4.1 Capacitive waste measures

The above table gives the capacitive count values of the biodegradableand the non-biodegradable waste based on theexperiments performed. The biodegradable wastegenerally wet waste has a capacitive count of more than40 followed by the polymer materials which are non-biodegradable and having a capacitive count of less than40.

4.4 SYSTEM DESIGN

4.4.1 BLOCK DIAGRAM OF THE SYSTEM

The entire system consist a transceiver system, means that it involved both the transmitting andReceiving units. On implementation process the transmitting part of the system placed along with the garbage binwhile the receiving part of the system located at the controlling room of the authorized administrator, at themunicipality office.

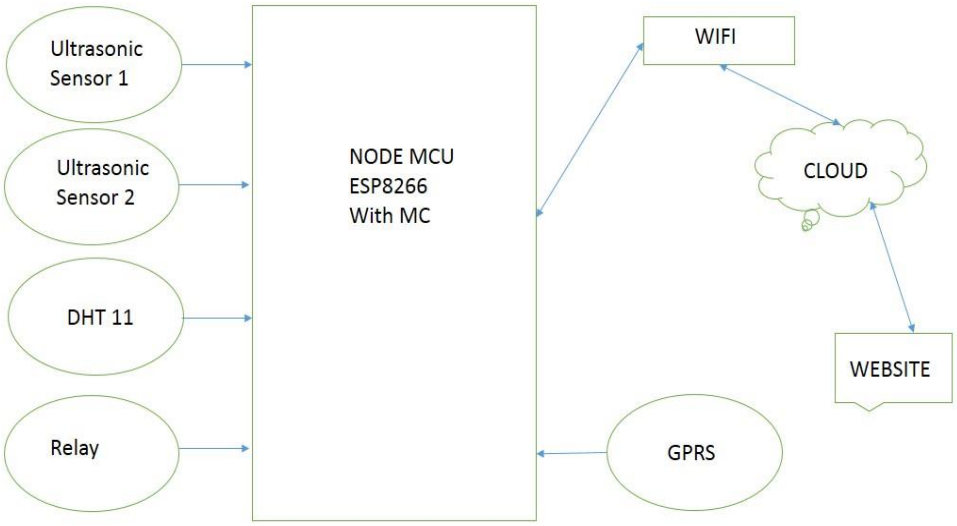


Fig 4.4 Block Diagram

4.4.2 DESCRIPTION OF BLOCK DIAGRAM

The block diagram represents the system at the transmitting part or the place of the garbage bin. Inthis part as the ultrasonic sensor sense the level of the bin and sends the data to the NODE mcu and the NODE mcuprocesses the data from ultrasonic sensor. Depending on the data processed the status of the garbage in thegarbage bin is informed to the society through the Website. When the garbage status is high or full the informationis passed to the control room through GSM and the PIR sensor starts to sense the motion around the bin andinform the surrounding people not to drop the garbage outside the bin while the bin is full.On the other hand, the block diagram also depicts the receiving side of the system in such a way that it receives the data from the transmitting part and processes it. The buzzer gives an alarm when data is receivedand displays the data on website. The control roomsend the SMS to the mobile of driver to collect the bin quickly.

CHAPTER 5

SEGRATION OF HETEROGENOUS BIO-DEGRADABLE WASTE

One of the complexities in waste disposal is the presence of solid waste materials and their decomposition structures. Currently, not all consumers have sufficient knowledge pertaining to biodegradable vs. compostable wastes. There is very little awareness and the fact that not all of the biodegradable products being bought and used provide solutions to present environmental troubles.

5.1 BIO-DEGREDABLE WASTE

Biodegradable waste is a type of waste, typically originating from plant or animal sources, which may be degraded by other living organisms. Waste that cannot be broken down by other living organisms are called non-biodegradable.

Biodegradable waste can be commonly found in municipal solid waste (sometimes called biodegradable municipal waste, or BMW) as green waste, food waste, paper waste, and biodegradable plastics. Other biodegradable wastes include human waste, manure, sewage, slaughterhouse waste. In the absence of oxygen much of this waste will decay to methane by anaerobic digestion.

5.1.1 USES OF BIODEGRADABLE WASTES

Biodegradable waste can often be used for composting which turns the waste into humus. It can also be used as a resource for heat, electricity and fuel in future, by using anaerobic digestion as it is being achieved by the swiss Kampongs treatment for 20 years now. This produces additional Biogas and still delivers usable nutrients that can be implemented to the soil. Especially animal-based kitchen scraps (such as leftover fish, meat), are best disposed this way (as these are best not composted). Finally note that leftover human food (vegetables, -no animal flesh-) can also be used as fodder to flightless birds, goats, pigs, sheep, or alternatively can be fed to birds, and other wildlife.

In the USA, approximately 50% of waste sent to landfills or incinerators is biodegradable; therefore, composting could create many new jobs, and recover significant resources that are being lost.

5.2 SEGREGATION UNFOLDING

5.2.1 SEPARATING BIO-DEGRADABLE WASTES

In this bin, only bio-degradable wastes are allowed to be dumped. And then those wastes are sent to Municipal. And after that , if wastes other than bio-degradable wastes are dumped , it is forcefully separated manually by working employees of municipal .

5.2.2 CONVERTING BIO-DEGRADABLE TO ORGANIC MANURE

Municipal solid waste management and treatment is a major problem faced by municipal bodies all over the world especially India. Due to increasing population and changing life style, the volume of the waste increases exponentially. In India, the waste is disposed by landfilling, composting, etc. However, these methods have certain disadvantages. In addition to this, Energy Crisis is another crucial problem faced by India. This paper presents a novel technique for treatment of biodegradable waste (which forms a major part of MSW). It involves processing of Biodegradable Waste by thermal process in presence of catalyst at high temperature to give liquid fertilizer and coke as product. This technology has a definite goal of exploiting the commercial aspects of two universal problems i.e. problem of managing the biodegradable waste in the municipal solid waste and overcoming the fuel shortage indigenously.

5.2.2.1 COLLECT HOUSEHOLD WASTE

Think carefully about the food products you are throwing away and whether they can be beneficial in making fertilizer. Avoid oils, grease, milk products, and fatty meats because these will only serve to make your compost a slushy mess. The things you should be on the lookout for are peelings from fruit and vegetables, nuts, eggshells, and over-ripened fruit. Also, make sure you can get your hands on some wood ash as this helps the composting process. This will be easy if you have an open fireplace.

5.2.2.2 COLLECT GARDEN WASTE

Save all leaves and clippings from any gardening work you do. Nothing will make the fertilizer more productive than a healthy amount of natural waste. Consider laying the leaves and garden waste around your lawn before you cut the grass. As your lawnmower goes over

the top, it will suck in the waste and mix it with grass cuttings. You can then empty the lawnmower onto your compost heap. Nearly all excess garden clippings can be put into the compost mix although it should ideally be added over a period of days for the ideal effect.

5.2.2.3 OTHER MATERIALS TO INCLUDE

Another organic material you can include is sawdust. Piles of sawdust can accumulate if you have been sawing wood or you can purchase large bags of it from any good gardening store. If you have your own livestock, add some of the manure to the compost pile. You can buy this in small amounts from nearby farms or from other locations that keep animals.

5.2.2.4 CREATE COMPOST

Place all of your compost materials into a compost barrel. This barrel should be slightly raised from the floor and should have a handle which you can turn to rotate the barrel and the compost. Spin the barrel at least two times per day. This will make all of the compost materials mix together and combine natural benefits to make a very effective fertilizer. Make sure the barrel has a couple of slits down the side to allow moisture to escape as the barrel is turned.

5.2.2.5 SPREAD

Once your compost has turned into a dark and soil-like mixture, it is ready to be spread. Use a large garden fork to pick the compost up and throw it over areas you would like to fertilize. Do not be afraid to be generous but remember that the compost is only a growing aid. Allow the compost layer to seep in and take effect before you fork on another load.

CHAPTER-6

6.1 CONCLUSION

The report presents a framework for waste management system. This solution is able to enrich the efficiency of waste bin collection activities and cost reduction. The implemented system on top of this framework can be further improved to perform real-time, reliable and efficient waste management system. customer complaints module will be added and integrates with the sms notification system to perform fast response. The map showing the waste bin actual coordinates stored in the database can be further leveraged by integration with gprs technology to give the current waste bin location. alert message can be produce if the waste bin has been reposition to other place or fall down. this monitors the waste collection status in real-time and based on the recorded information they able to measure their operational performance, predict future operation requirements and plan for better service to deliver . And after collecting debris it is then converted into organic manure and it will be sent to industry to make profits. Thus, by our project, it is very easy to maintain the city in a hygiene manner and makes the people free from toxic substances.

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