IOT BASED LOW COST AND EFFICIENT DISH CLEANER

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Abstract

A dishwasher is an appliance used for cleaning dishes, cutlery, and other kitchen utensils. It is typically a large rectangular box with a door on the front and a built-in motor and pump to circulate water and detergent. The user loads the dishwasher with dishes, cutlery and other items, adds detergent to the dispenser, and then turns it on. The dishwasher circulates hot water and detergent, washing and rinsing the items, then drains the dirty water. The user can then unload the clean items and store them. The Multi-jet technology is used in dishwasher. Multi-jet technology is a type of advanced washing technology used in many modern dishwashers. It utilizes multiple water jets to create a powerful spray that is highly effective at removing dirt, grease and food residue from dishes and utensils. The jets are strategically placed inside the dishwasher to create an effective cleaning cycle. Dishwashers come in a variety of sizes, designs, and features, including energy-saving and water-saving options. Many dishwashers are also equipped with advanced sensors and timers to ensure optimal cleaning performance.

Keywords: Dish washer, IoT, Low Power, Cost efficient

1. Introduction

The dishwasher was invented in the late 1800s by a German engineer named Josephine Cochran. She was inspired to create the machine after seeing her servants struggle to keep up with the stack of dishes from her dinner parties [1]. She received a patent for her invention in 1886 and exhibited it at the 1893 World's Fair in Chicago. The first commercial dishwasher was produced in the early 1900s, but it wasn't until the 1950s that the dishwasher began to take off. During this time, dishwashers became more affordable and began to appear in more and more American homes. Modern dishwashers are designed to be more efficient and user-friendly than ever before. Today, dishwashers come in a variety of sizes and styles, from standard models to more advanced models with additional features [4]. Most dishwashers come with a variety of wash cycles and settings, allowing users to customize the cleaning cycle to suit their needs. Many models also come with additional features such as a sanitizing cycle, a heated dry cycle, and a delay start. The most efficient dishwashers use less water and energy than hand-washing dishes. Many dishwashers come with a "water saver" feature, which reduces the amount of water used by up to 25 percent [6]. Additionally, most dishwashers are Energy Star-certified, meaning they meet strict energy efficiency standards set by the government. Dishwashers also help to reduce the spread of germs and bacteria. The hot water and detergent used to clean the dishes helps to kill any harmful bacteria that may be present. Additionally, the drying cycle helps to reduce the amount of moisture left on the dishes, further reducing the risk of bacterial growth [11]. While the dishwasher is a convenient and efficient appliance, it is important to use it properly. Dishwashers should be loaded properly to ensure that dishes are properly cleaned. Additionally, it is important to use the appropriate deter-

gent and rinse agent for the best results. Overall, the dishwasher is a convenient and efficient appliance that saves time, money, and energy [2]. It is important to use it correctly to ensure the best results and to reduce the spread of bacteria and germs. With the wide variety of models and features available, there is sure to be a dishwasher that is perfect for any household [10].

Dishwasher was firstly invented by Joel Houghton in the year 1850. She made it by using wooden box but the first research paper was published in the year 1980. This research was continued thinly in the years 1989 to 2000. Coming to the years 2003 to 2017 research was increased. Then in the years 2018 to 2022 nearly 27 research papers were published and the research is going on. Germany placed first in the usage of dishwashers and then USA placed second, Sweden, UK, Turkey, Slovenia placed next. Remaining countries are using very a smaller number of dishwashers [1]. In 1989 thermal model was developed to maintain hygienic [2]. Dishwashers mainly work with the water so water conservation should be there in the Dishwashers. Conservation of water was proposed in 2003[3]. Water, energy, cost and hygiene are treated as efficiency. If researchers want to increase efficiency, they have to research each of the above individually [4]. Dish washers, which are invented before 2012 are consuming more energy so in 2013 energy saving methodology was proposed. This methodology consists of mode system to save the power according to the type of dishes [5]. Some modes were got defected due to life time of components used were identified in 2019 [6]. In the same year researchers identified that where the water was wasted in the dishwashers [7]. Dishwasher system was developed portable fabrication and portable design with water sprinkling arm in 2020[8]. An automatic dishwasher system was developed to save the power and make simple to putting and taking of vessels in 2021[9]. In 2019 rubber seal used to kill bacteria [10]. Then in 2022 thermal heaters were developed to kill bacteria [11]. By using these factors Low-cost dish cleaner was made with high efficiency.

2   Existing method

The existing methodology of dishwasher involves several steps. The first step is pre-washing. During pre-washing, the dishes are rinsed with hot water to remove any large food particles. Pre-washing also helps to reduce the amount of detergent needed during the main washing cycle. The second step is the main washing cycle. During the main washing cycle, detergent is added to the water and the dishes are washed with a combination of hot water, detergent, and mechanical action. The water is usually heated to between 55 and 70 degrees Celsius to ensure that the detergent is effective. The mechanical action is usually provided by a spray arm which rotates and sprays the dishes with hot water and detergent. The third step is rinsing [2]. During rinsing, the dishes are sprayed with hot water to remove any remaining detergent. This water is usually heated to between 55 and 70 degrees Celsius. The fourth step is drying. During drying, the dishes are heated to between 70 and 80 degrees Celsius to evaporate the remaining water. This is usually done with an electric heating element or a fan. Finally, the dishes are removed from the dishwasher and put away. The dishwasher's cycle is controlled by a timer, which is usually set to a specific number of minutes. The cycle is usually started by pressing a button or turning a knob. The cycle usually takes anywhere from 25 to 90 minutes, depending on the type and size of the load. Most dishwashers have filters that clean the water before it enters the dishwasher and again before it is used to rinse the dishes. This helps to ensure that the water is clean and free of food particles and other debris. The dishwasher also has a number of safety features. For example, it has a thermostat which shuts off the heating element if the water temperature exceeds a certain level [2]. The dishwasher also has a pressure switch which shuts off the water if the pressure becomes too high. In summary, the existing methodology of dishwasher involves several steps, including pre-washing, washing, rinsing, drying, and removing the dishes. The cycle is usually controlled by a timer and

takes anywhere from 25 to 90 minutes. The dishwasher also has a number of safety features to ensure that the water is clean and free of food particles and other debris.
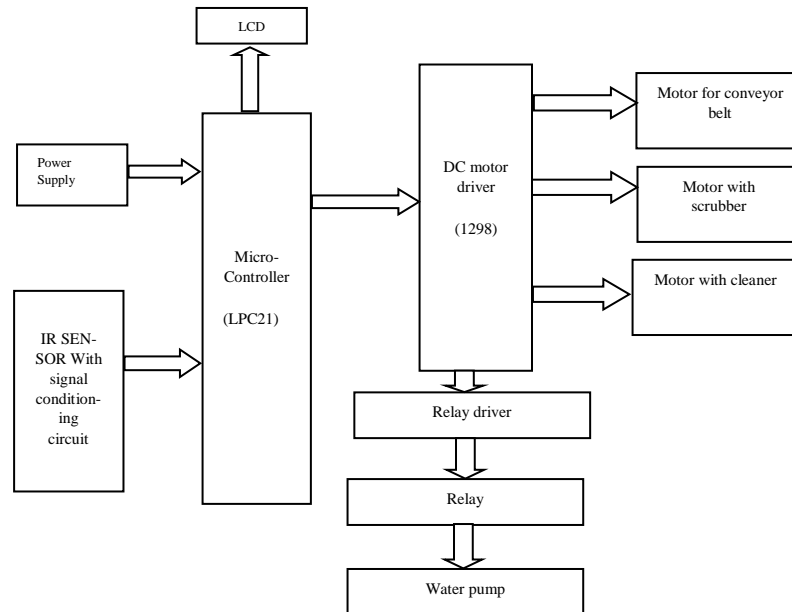
2.1 Block diagram:

Fig. 1. Existing block diagram

As shown in Fig.1 consists of:

LPC21 Microcontroller:

The LPC21 microcontroller is a low-cost, high-performance 32-bit MCU based on the ARM7TDMI-S processor. It is commonly used in household appliances, including dishwashers, due to its reliability, versatility, and low power consumption.

In a dishwasher, the LPC21 microcontroller is responsible for controlling various functions, such as water flow, temperature control, and the timing of each cycle. It uses a combination of input sensors and output actuators to monitor and adjust the various parameters of the dishwasher operation.

The LPC21 microcontroller is designed to operate in harsh environments, making it ideal for use in appliances like dishwashers that are exposed to high levels of heat and moisture. Its small size and low power consumption make it an efficient solution for controlling the complex processes involved in a dishwasher's operation.

1298 DC motor driver:

The DC motor driver 1298 is an electronic circuit used to control the speed and direction of a DC motor, commonly found in dishwashers. This specific driver model is designed for brushed DC motors and includes features such as PWM control, over-current and over-temperature protection to ensure safe and reliable operation. In a dishwasher, the 1298 DC motor driver is typically used to control the operation of the spray arm motor. It receives signals from the dishwasher's control system to adjust the motor's speed and direction based on the selected wash cycle. The 1298 DC motor driver is essential for precise motor control, optimal performance, and energy efficiency in dishwashers.

3. Proposed Methodology

The integration of the Internet of Things (IoT) in household appliances such as dishwashers has revolutionized the way we interact with these devices. By connecting dishwashers to the internet, it is possible to remotely monitor and control them, providing a more convenient and efficient user experience. Here are some ways that IoT can be integrated into dishwashers:

i. **Smart Control:** IoT-enabled dishwashers can be controlled remotely via a mobile app or a virtual assistant. This allows users to monitor the dishwasher's progress, set wash cycles, and adjust the temperature and other settings from anywhere, anytime. This feature saves time and makes it easier for users to manage their busy schedules.

ii. **Energy Efficiency:** With IoT integration, dishwashers can be programmed to operate during off-peak hours when electricity is cheaper. Users can also receive alerts if the dishwasher is left running after the cycle is complete, reducing unnecessary energy consumption.

iii. **Predictive Maintenance:** IoT-enabled dishwashers can monitor their own performance and detect potential issues before they become major problems. This allows for scheduled maintenance and repairs, minimizing the risk of breakdowns and reducing the cost of repairs.

iv. **Water Management:** Dishwashers equipped with IoT sensors can detect the level of water hardness and adjust the wash cycle accordingly, reducing water waste and preventing damage to dishes. These sensors can also alert users if there is a leak, preventing water damage and potential safety hazards.

v. **Personalized Wash Cycles:** IoT-enabled dishwashers can use machine learning algorithms to learn the user's washing habits and adjust the wash cycle accordingly. This feature ensures that dishes are cleaned to the user's satisfaction while minimizing water and energy waste.

Overall, the integration of IoT in dishwashers brings a host of benefits to users, including increased convenience, energy efficiency, and cost savings. As IoT technology continues to advance, we can expect to see even more innovative features integrated into household appliances like dishwashers.

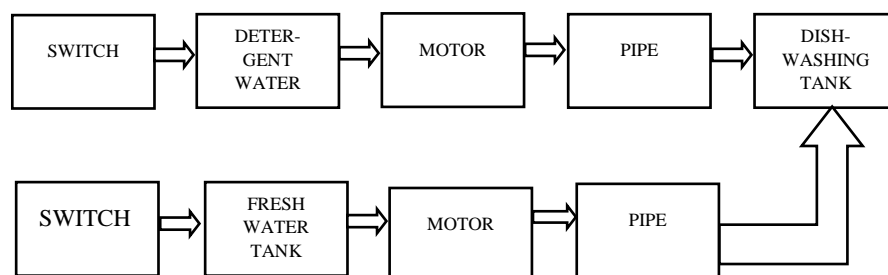### 3.1 Block diagram:

Fig. 2. Block diagram of proposed system

As shown in Fig.2 the proposed system consists of:

Detergent Water tank:

The detergent water tank in a dishwasher is a container located inside the appliance that holds and dispenses detergent during the wash cycle. It is typically located on the dishwasher's door and can be filled with a variety of dishwasher detergents in different forms, such as powders, liquids, or pods. The detergent water tank is an important part of the dishwasher, as it ensures that the detergent is dispensed at the right time during the wash cycle, ensuring effective cleaning. Most modern dishwashers have automatic detergent dispensers that release the right amount of detergent based on the selected wash cycle, providing a convenient and efficient way to clean dishes.

Motor:

The motor used in a dishwasher is typically a type of electric motor known as a brushed DC motor. It is responsible for powering the dishwasher's spray arm, which sprays water and detergent onto the dishes. The motor is located at the bottom of the dishwasher and is connected to the spray arm via a driveshaft. It operates on a voltage of typically 120V or 240V, and its speed and direction are controlled by a motor driver circuit such as the DC motor driver 1298. The motor's power and torque output are critical factors in determining the dishwasher's performance and efficiency, making it an essential component of the appliance.

Fresh water tank:

A fresh water tank in a dishwasher is a compartment that stores clean water to be used during the wash cycle. It is typically located at the bottom of the dishwasher and is filled with water from the household water supply. During the wash cycle, water is pumped from the tank to the dishwasher's spray arm, which sprays the water and detergent onto the dishes to clean them. Some dishwashers may also have a filtration system in the fresh water tank that removes impurities from the water, ensuring that only clean water is used for washing dishes. The size of the fresh water tank can vary depending on the dishwasher model, but it is an essential component of the appliance that ensures effective cleaning and rinsing of dishes.

Dishwashing tank:

A dishwashing tank is a crucial component of a dishwasher. It is where the cleaning process takes place, as it holds the water and detergent that washes and rinses the dishes. The tank is typically located at the bottom of the dishwasher, and it is connected to a pump that circulates the water throughout the machine. The tank has several features such as filters, jets, and spray arms that help in removing food particles and stains from the dishes. The water temperature and pressure are also controlled within the tank to ensure effective cleaning. Proper maintenance and cleaning of the dishwashing tank are essential to ensure the longevity and efficiency of the dishwasher.

4   Components of Dish cleaner

4.1 Main controller board (MCB): The Main Controller Board (MCB) in a dishwasher is the electronic control unit responsible for controlling the various functions of the dishwasher. It is essentially the "brain" of the dishwasher, receiving input from sensors and switches, and sending commands to the various components that make up the machine. The MCB is typically located inside the dishwasher door, and is connected to the various components of the dishwasher through a series of wires and connectors. It may also be connected to external controls such as buttons and displays on the front panel of the dishwasher. The MCB is responsible for controlling functions such as water flow, temperature, and the duration and sequence of cycles. It also monitors sensors such as the water level sensor, temperature sensors, and door switches to ensure that the dishwasher is operating safely and efficiently. Modern MCBs may feature advanced technologies such as microcontrollers, which allow for more precise control and monitoring of dishwasher functions.

They may also be designed to communicate with other smart home devices, allowing for more seamless integration into a smart home system.

4.2 LED display: An LED display in a dishwasher is a digital display that provides information about the status and settings of the dishwasher. It typically consists of a series of LED lights arranged in a specific pattern to display numbers, symbols, and words. The LED display is usually located on the front panel of the dishwasher and may display information such as the cycle time remaining, the selected cycle, the water temperature, and any error codes or messages. Some LED displays may also include additional features, such as a delay start timer or a child lock. The LED display is powered by the dishwasher's electronic control unit, which receives input from sensors and switches and sends commands to the various components of the dishwasher. It provides a convenient way for users to monitor the progress of their dishwashing cycle and adjust settings as needed.LED displays in dishwashers are typically easy to read and provide clear, concise information about the dishwasher's operation. They are also energy-efficient and long-lasting, making them a reliable and cost-effective choice for displaying information in a dishwasher.

4.3 Heating coil: A heating coil in a dishwasher is a heating element that is responsible for raising the temperature of the water in the dishwasher during the wash cycle. It is typically located at the bottom of the dishwasher tub and is designed to be submerged in water. The heating coil is made of a metal alloy that is resistant to corrosion and able to withstand high temperatures. When the dishwasher is turned on and the wash cycle begins, the heating coil is energized; causing it to heat up and transfer heat to the water in the dishwasher. The heating coil serves several important functions in a dishwasher. First, it helps to activate the detergent by raising the water temperature to a level that is optimal for cleaning. Second, it helps to sterilize the dishes by raising the water temperature to a level that kills bacteria and other microorganisms. Finally, it helps to dry the dishes by creating a warm, dry environment inside the dishwasher after the wash cycle is complete. If the heating coil in a dishwasher fails, the dishwasher may not be able to effectively clean and sanitize dishes, and dishes may come out wet or not fully dry. In such cases, it may be necessary to replace the heating coil or have it repaired by a qualified technician. Proper maintenance and cleaning of the heating coil can help to prolong its lifespan and ensure that it functions effectively for many years.

4.4 Four channel relay: A four-channel relay in a dishwasher is a device that allows the dishwasher to switch between different modes of operation. The relay is typically controlled by the dishwasher's electronic control unit and is responsible for switching power to various components within the dishwasher. In a dishwasher, the four channels of the relay are used to control different functions of the machine. For example, one channel may be used to control the heating element, another channel may be used to control the water pump, a third channel may be used to control the detergent dispenser, and a fourth channel may be used to control the drain valve. By switching power to these different components, the four-channel relay allows the dishwasher to operate in different modes. For example, in the wash mode, the relay may switch power to the heating element and water pump to heat the water and circulate it around the dishwasher tub. In the rinse mode, the relay may switch power to the water pump and detergent dispenser to rinse the dishes and dispense rinse aid.

4.5 Node MCU: Node MCU is a development board based on the ESP8266 microcontroller, which is commonly used in the Internet of Things (IoT) applications. Node MCU is a small, low-cost board that provides Wi-Fi connectivity, making it easy to connect devices to the internet. Node MCU can be used in a dishwasher to add smart functionality to the appliance. With Node MCU, the dishwasher can be connected to a home Wi-Fi network, allowing users to remotely monitor and control the dishwasher from a smartphone or other internet-connected device by adding Node MCU to a dishwasher, users can receive notifications when the wash cycle is complete,

remotely start or stop the dishwasher, and adjust settings such as the wash cycle and temperature. This can provide greater convenience and flexibility for users, as well as potential energy savings by allowing users to start the dishwasher during

4.6 Motor controllers: The motor controller in a dishwasher is responsible for controlling the motor that runs the dishwasher. It ensures that the motor runs at the correct speed and direction and turns the dishwasher pump on and off. The controller also controls the flow of water and the temperature of the water in the dishwasher. In older dishwashers, the motor controller was typically an electromechanical timer that relied on a series of gears and switches to control the motor. More modern dishwashers use electronic controllers that are typically made up of a microprocessor, memory, and a number of input and output ports. The electronic controller receives input from sensors throughout the dishwasher that monitor things like water temperature, water level, and the position of the dishwasher door. Based on this input, the controller sends signals to the motor to turn on or off, to adjust the speed, or to change the direction of rotation. Overall, the motor controller is an essential component of the dishwasher, and it plays a critical role in ensuring that the dishwasher runs smoothly and efficiently. Without a functioning motor controller, the dishwasher would be unable to properly clean dishes, and it could potentially be dangerous to operate.
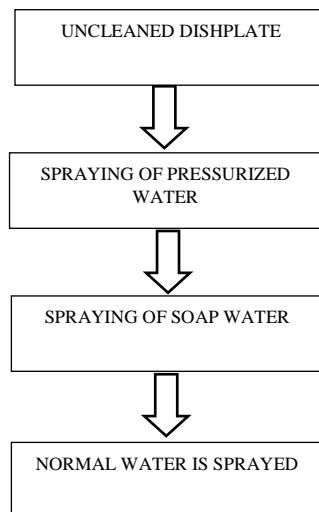
5. Design flow

UNCLEANED DISHPLATE

SPRAYING OF PRESSURIZED WATER

SPRAYING OF SOAP WATER

NORMAL WATER IS SPRAYED

Fig. 3 Design flow of proposed system

There are four steps in the design flow as shown in the Fig.3:

Step 1: When keeping unclean dishes in the dishwasher, it is important to follow a few key steps to ensure that the dishes are properly cleaned and sanitized. First, remove any large pieces of food or debris from the dishes before placing them in the dishwasher. This will help prevent clogs and ensure that the dishwasher's cleaning mechanisms can reach all surfaces of the dishes. Next, arrange the dishes in the dishwasher making sure that they are not too tightly packed together. Be sure to load the dishwasher with the appropriate dishwashing detergent and turn on the appropriate wash cycle. After the dishwasher has completed its cycle, carefully remove the cleaned dishes and allow them to air dry before putting them away. It is important to clean the dishwasher regularly to ensure that it is working properly and that the dishes are being thoroughly cleaned and sanitized.

Step 2: Spraying of pressurized water is an essential component of the cleaning process in dishwashers. When dishes are loaded into the dishwasher, water is sprayed onto the dishes at high pressure to remove any food particles or other debris. The pressurized water comes from spray arms, which are located at the bottom of the dishwasher. As the dishwasher runs, water is continu-

ously pumped into the dishwasher and sprayed onto the dishes through the spray arms. The force of the water breaks down and removes any food particles or other debris on the dishes. The pressurized water also helps to rinse away any detergent or soap residue that may be left on the dishes after the cleaning cycle. To ensure that the dishes are properly cleaned and sanitized, it is important to make sure that the spray arms are not blocked or obstructed by dishes or other items in the dishwasher. Regular cleaning and maintenance of the dishwasher can also help to ensure that the spray arms are working properly and effectively.

Step 3: Spraying of soap water, also known as detergent solution, is an essential step in the cleaning process of a dishwasher. The soap water is sprayed onto the dishes to help break down and remove food particles, grease, and other debris. The detergent solution is added to the dishwasher's detergent dispenser and is automatically released during the cleaning cycle. As the dishwasher runs, the water is mixed with the detergent solution and sprayed onto the dishes through the spray arms. The detergent solution contains surfactants, enzymes, and other cleaning agents that work together to break down and remove stubborn stains and debris from the dishes. Some dishwasher detergents also contain additives to help prevent hard water stains or to add shine to glassware. It is important to use the correct amount of detergent for your dishwasher and to make sure that the detergent dispenser is properly filled. Overuse of detergent can lead to excess suds and poor cleaning results, while using too little detergent may result in incomplete cleaning of dishes. It is also important to choose a detergent that is compatible with your dishwasher and the type of water you have in your home.

Step 4: In addition to spraying pressurized water and soap water in the dishwasher, normal water is also sprayed during the cleaning process. This is done to rinse away any remaining soap or detergent residue, as well as to ensure that the dishes are thoroughly cleaned and sanitized. After the soap water has been sprayed onto the dishes and the cleaning cycle is complete, the dishwasher will automatically initiate a rinse cycle. During the rinse cycle, normal water is sprayed onto the dishes to remove any remaining soap or detergent residue. This is important because leaving soap or detergent residue on the dishes can cause streaks, spots, or other marks on the dishes. The normal water sprayed during the rinse cycle is typically at a lower pressure than the pressurized water used during the cleaning cycle. This is because the goal during the rinse cycle is to rinse away soap residue, rather than to aggressively scrub away food particles or other debris. The dishwasher will continue to spray normal water during the rinse cycle until all of the soap or detergent residue has been removed. Once the rinse cycle is complete, the dishwasher will automatically shut off, and the dishes can be removed and dried.

6. Implementation & Results:

Fig. 4. Interface of mobile application

Basically, there are six modes of operations as shown in Fig.4. They are:

i) For heavily solid crockery

The mode of operation in a dishwasher for heavily solid crockery typically involves a high-temperature wash and a longer cleaning cycle. The high temperature wash helps to break down and remove tough stains and food particles from heavily solid crockery, such as pots and pans. Before loading heavily solid crockery into the dishwasher, it is important to remove any large pieces of food or debris, as well as to make sure that the dishwasher is loaded properly. Heavily solid crockery should be placed in the bottom rack of the dishwasher, with space between each item to allow for proper cleaning and water circulation. Once the dishwasher is loaded, select the appropriate wash cycle for heavily solid crockery. This may be a heavy-duty or pots and pans cycle, which typically involves a longer wash time and higher water temperature than other cycles. After the cleaning cycle is complete, allow the dishwasher to cool down before opening the door and removing the heavily solid crockery.From the Fig.5 the time consumption is around 2 hours, 20 minutes.

Fig.5.For heavily solid crockery mode

ii) For normally solid loads: A dishwasher for normally solid loads works by spraying water and soap onto the dishes, which helps to break down and remove any food particles, grease, or other debris. The dishwasher has a pump that circulates water through the spray arms, which are located at the bottom and top of the dishwasher. The water is pressurized to ensure that it reaches all areas of the dishes. Once the cleaning cycle is complete, the dishwasher drains the soapy water and rinses the dishes with clean water to remove any remaining soap or detergent residue. Finally, the dishwasher may air dry the dishes or use a heating element to dry them. The entire cycle is controlled by the dishwasher's computer, which monitors the temperature, water pressure, and other factors to ensure that the dishes are properly cleaned and sanitized.From the Fig.6the time consumption is around 2 hours

Fig.6.For normally solid loads

iii) ECO Mode: The way a dishwasher works in ECO Mode is similar to how it works for other modes, with some key differences aimed at reducing energy consumption and water usage. In ECO Mode, the dishwasher may use less water and energy by adjusting the length of the cleaning cycle and the water temperature. The dishwasher's sensors monitor the temperature and water

pressure to ensure that the dishes are properly cleaned and sanitized while minimizing the amount of energy and water used. Some dishwashers may also have a feature called "smart wash" or "auto sense" that adjusts the cleaning cycle based on the level of soiling detected, which can further reduce energy and water usage. The end result is a cleaning cycle that is gentler on the environment and your utility bills, while still effectively cleaning and sanitizing your dishes.From the Fig.7the time consumption is around 3 hours.

Fig.7. ECO mode

iv) Ceramic Mode: Ceramic Mode is a feature available in dishwasher that uses a higher water temperature and longer washing cycle to effectively clean and sanitize ceramic dishes and other kitchenware. This mode is designed to provide a more thorough cleaning and sanitizing process for items that are more difficult to clean, such as dishes with baked-on food or coffee and tea stains. When the Ceramic Mode is selected, the dishwasher will use a higher water temperature to help break down and remove stubborn stains and food particles. The temperature is typically around 160 to 170 degrees Fahrenheit, which is higher than the normal washing temperature of most dishwashers. The longer washing cycle, usually around two and a half hours, allows the dishwasher to soak and clean the dishes more thoroughly. It's important to note that not all dishwashers have a Ceramic Mode, and not all ceramic dishes and kitchenware require this type of cleaning. Always check the manufacturer's instructions and care labels to determine the best cleaning method for your dishes and other items. Additionally, some delicate ceramic items may not be suitable for use in the dishwasher at all and should be hand-washed instead. From the Fig.8the time consumption is around 1hours, 15 minutes.

Fig.8.Ceramic Mode

v) Normal wash: Normal wash is the standard and most commonly used washing cycle in a dishwasher. It is designed to clean moderately soiled dishes using a combination of hot water, detergent, and various spray patterns to remove food particles and stains. When the Normal wash cycle is selected, the dishwasher fills with hot water and begins to circulate it through the spray arms to clean the dishes. The hot water is typically around 120 to 140 degrees Fahrenheit, which helps to dissolve and remove food particles and stains. During the washing process, the dishwasher uses different spray patterns to ensure that all surfaces of the dishes are cleaned. The water is sprayed from the bottom of the dishwasher up to the top, and the spray arms rotate to reach all areas of the dishwasher. The detergent is also dispensed during the washing cycle to help break

down and remove any remaining food particles and stains. Once the washing cycle is complete, the dishwasher will drain the water and begin the drying cycle, which typically uses heated air to dry the dishes. It's important to note that while the Normal wash cycle is suitable for most dishes and kitchenware, heavily soiled or greasy items may require a longer or more intensive wash cycle, such as the Heavy or Pots and Pans cycle. Additionally, delicate items, such as crystal may not be suitable for the Normal wash cycle and should be hand washed instead.From the Fig.9the time consumption is around 1hours, 30 minutes.

Fig.9. Normal wash

     vi) Glass mode: Glass Mode is a specific washing cycle in some dishwashers that is designed to safely and effectively clean delicate glassware. This cycle typically uses cooler water temperatures and gentle washing action to prevent damage to fragile items. When the Glass Mode is selected, the dishwasher fills with water at a temperature of around 120 degrees Fahrenheit, which is cooler than the temperature used in other wash cycles. The cooler temperature is intended to reduce the risk of thermal shock, which can cause delicate glassware to crack or break. During the washing cycle, the dishwasher uses a gentle spray pattern and lower water pressure to prevent the glassware from knocking against other items or the dishwasher itself, which could cause damage. The detergent used in the Glass Mode is also specially formulated to be gentler on delicate glassware. Once the washing cycle is complete, the dishwasher will typically use a lower temperature for the drying cycle or may even skip the drying cycle altogether, as high temperatures can also cause thermal shock and damage delicate glassware. It's important to note that not all dishwashers have a Glass Mode, and not all glassware requires this type of cleaning. Always check the manufacturer's instructions and care labels to determine the best cleaning method for your glassware. Additionally, some delicate glass items may not be suitable for use in the dishwasher at all and should be hand-washed instead.From the Fig.10the time consumption is around 30 minutes.
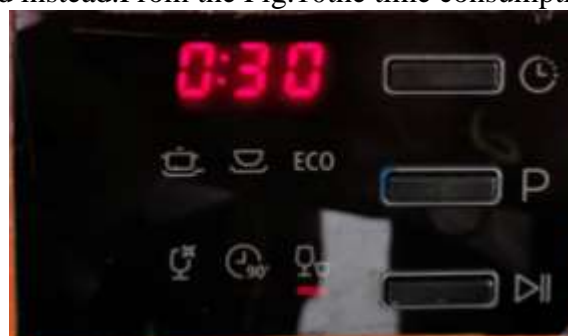

Fig.10.Glass mode

7. Conclusion:

In this paper, the IoT technology allows for the dishwasher to be connected to the internet and other smart devices, like mobile phones and laptops etc. they are providing real-time monitoring and control. The mobile application enables users to operate the dishwasher remotely, view the status of the wash cycle, and receive alerts when the cycle is complete. Additionally, the applica-

tion can suggest the most efficient and eco-friendly wash cycle based on the load, thereby saving energy and water. Overall, the use of IoT and mobile application technology in dishwashers can make the cleaning process more efficient, convenient, and eco-friendly.

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