

Autonomous Fresh Juice Machine

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Abstract--- The traditional/present way of juice making involves more labor as well as time conception. The customers have to wait for a long time to get their juice/shake ready. While considering about the hygiene and quality whatever the environment is good the quality won't be unique and clean. To ensue hygiene and quality with no labor we have designed our automation system. This idea mainly focuses on the autonomous fresh juice maker and delivery machine with customizations (based on the customers preference). In our system it is fully automated using micro-controller, pumps, solenoid valves, pipes, containers, mixers, filters and some sensors like (load censor / force sensors). By integrating micro controller with the other devices and sensors based on the measured time the functions can be operated. Some customized software's are also enabled in this system to have a user-friendly interface. Thus, the system enables to prepare fresh juice as per the customer's requirement in sequential manner. The order is placed through the input display, which displays the fruit or vegetables available, its corresponding price and offers of the day. The quantity, sugar level, temperature, milk/water can be specified by the customer in the order through the input display and the mode of payment can be cash or card or online. Once the order has been placed the autonomous juice maker prepares the shake/juice by adding weighted quantity of fruit, measured quantity of sugar, milk/water, ice as per the order to the blender. After loading the ingredients, blender blends it smoothly and filters the juice/shake. The filtered contents are transferred to the cups. This whole process takes approximately only 2-3 minutes. So, many juices can be sold in a minimum time. Upon implementation of this technology, we can reduce the need for man power in the preparation of juice in stores and the risk of communicable disease and also price of the juice. Hence this system would change the surroundings in accordance with technology.

Keywords--- Fresh Juice, Automatic, Machine

I. INTRODUCTION

The present way of juice making involves more labor as well as time conception. The customers have to wait for a long time to get their juice/shake ready. While considering about the hygiene and quality it won't be unique and fresh. To ensure hygiene and quality with no manpower we have designed our automation system. Transformation of locally produced fruits into juice is the purpose of a juice maker. Several fruit juice extractors exist but there is need to make available juice extractor which is autonomous. Our system is fully automated by using microcontroller, pumps, solenoid valves, pipes, copper containers, mixers, filters and some sensors like load sensor/force sensors. The juices produced from the extractor are of good quality which further proves the effectiveness of the extractor. The order is placed through the input display, which displays the fruits available, it's corresponding price and offers of the day. The quantity, sugar level, temperature, milk/water can be specified by the customer in order through the input

display and the mode of payment whether cash or card or online can also be specified.. So many juices can be sold within a limited time thus increasing market size. It is well preserved and easier to use and the juices seems to last longer. You don't need any manpower to handle this system that's the biggest advantage you will gain by using this system obtaining the exact taste of the fruit and minimal cost as per the user's needs. Hence this system would change the surroundings in accordance with technology.

II. EXISTING METHODOLOGY:

The existing method of the autonomous juice maker is present only for making soda and not for making fresh quality juices. Only the manual method has been present for making fresh juice. Manual systems put pressure on people to be correct in all details of their work at all times, the problem being that people aren't perfect, however much each of us wishes we were. With manual systems the level of service is dependent on individuals and this puts a

requirement on management to run training continuously for staff to keep them motivated and to ensure they are following the correct procedures. Manual methods are prone to get damage they are not accurate at all times due to human error, hence it is less reliable. Manual methods consumes more time and the quality of the juice could also differ. The another major drawback is that we can only make small amounts of juice and at a small scale.

III. NOVELTY

As by the name the system is completely autonomous. The user can specify the amount and level of sugar content to be added and he can specify the level of water or milk that is to be added to the juice. Automation serves as the best tool in today's technology because we don't depend or rely on any human resources for making fresh juice that's the biggest advantage you will get on automation thus saving labor charges and the quality of the juice will be very high compared to any manual methods. Autonomous juice maker ensures fresh quality of juices with 100% accuracy. Customer queries can also be analyzed by autonomous system thus ensuring safety and improving the productivity rate of the products as it is 24/7. Automated systems decreases cost-per-piece while improving quality. This allows you to better compete on a global scale. Another major advantage is that because of its consistency and improved part production and quality. This innovative method generate higher sales in market because of its unique features, service, higher production rates, and ensuring good quality supply of juices.

IV. MATERIALS REQUIRED:

- Microcontroller
- Load cell
- Solenoid valve
- Pump
- Refrigerator
- Pipes
- Containers
- Blender
- Filter
- Cup

V. MICROCONTROLLER:

Microcontroller is a compact integrated circuit designed to govern a specific operation in a system. Microcontroller used in this maker is ATMEGA. It controls overall flow and process of a maker. Input display, solenoid valve, load cell, pump is interfaced with the microcontroller. Input to

the microcontroller is fed from the input display. Quantity of a fruits, sugar level, shake/milk, coldness level is taken as a input. From these parameters' threshold weight, seconds are calculated for the load cell and pump correspondingly and also the opening and closing of each solenoid valves are also performed. The load cell is connected with the HX711 amplifier module, then this HX711 amplifier module is interfaced with the microcontroller. The quantity of the fruits is taken as a threshold weight to the load cell, but not directly . The quantity of a fruit is multiplied by 200(For one juice/shake 200g of fruits are used) and the multiplied output is fixed as a threshold weight of the load cell of the specified fruit. The pump is directly interfaced with the microprocessor. The level of sugar is taken as an threshold seconds, but not directly. The operating seconds for a pump is predefined for the corresponding sugar level. For the juice/shake the quantity of the juice is taken as a threshold seconds, by multiplying the quantity of the juice by 250(for one juice/shake 250ml of water/milk is used) and the multiplied output is taken as a threshold seconds.

VI. LOAD CELL:

Load cell is a type of force sensor. Load sensor is a transducer(converts energy from one form to another) which converts the applied force into a measurable electrical output. There are many types of load cells. They are,

- Hydraulic load cell
- Pneumatic load cell
- Strain gauge load cell.

In this juice maker we have used four wired linear strain gauge load cell.



FIGURE: FOUR WIRED STRAIN GAUGE LOAD CELL

In juice maker to get accurate value and since the voltage change is tiny we connect this load cell to a HX711 amplifier module and then this HX711 amplifier module with strain gauge is connected to the microcontroller.



FIGURE: HX711 AMPLIFIER MODULE

WHY WE HAVE USED A LOAD CELL IN THIS JUICE MAKER?

Because to weigh the amount of fruit that has to be taken from the container and that number of fruits only dropped into the blender. The microcontroller is programmed in such a way that it calculates the threshold value as per the customer requirement. Until this threshold value becomes equal to the weight measured by the load cell, the solenoid valve will be opened.

VII. SOLENOID VALVE:

The difference between normal valve and solenoid valve is that, the normal valve is operated manually but a solenoid valve is an electrically controlled valve. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core (plunger) in its centre. At rest, the plunger closes off a small orifice. An electric current through the coil creates a magnetic field, this magnetic field exerts an upward force on the plunger opening the orifice. This is the basic principle which is used to open and close solenoid valve. In this juice maker we have used direct acting and 2-way type solenoid valve because we need the solenoid valve only for opening and closing purpose.



FIGURE: SOLENOID VALVE

When this valve is opened the content from the respective containers will flow through the inlet port into the blender/filter via outlet port in sequential manner.

VIII. PUMP

Pump is a device that moves fluids by mechanical action, typically converted from electrical energy into hydraulic energy. The purpose of implementing the pump in the maker is to eject the sugar solutions, milk, water from their respective containers to the pipes. The pump implemented in the maker is ANMSALES-P2502 12V DC BRUSHLESS PUMP with the specification of maximum flow rate of 2L/min, minimum lift of 2.2mm and it can transfer any type of fluids such as cold/hot fluids and oil.

Working Principle of Pump in the maker:

The pumps are interfaced with the microcontroller. The operating time of each pump is controlled by the microcontroller. Once the order has been placed, the operating time of each pump is calculated by taking level of sugar solution, water and milk specified by the customer.

SUGAR SOLUTION LEVEL	RANGE OF SUGAR SOLUTION IN ML	OPERATING TIME OF PUMP IN SEC
NO SUGAR	0	0
LOW	33	1
MEDIUM	50	1.75
HIGH	70	2.15

TABLE: LEVEL, RANGE AND OPERATING TIME OF PUMP FOR SUGAR SOLUTION

QUANTITY	RANGE OF SOLUTION IN ML	OPERATING TIME OF PUMP IN SEC
1	250	8
2	500	16
3	750	24

TABLE: QUANTITY, RANGE AND OPERATING TIME OF PUMP FOR WATER/MILK

IX. REFRIGERATOR

The whole system is designed as a refrigerated cooling system. This design is implemented to store the fruits, milk under a fresh condition. The cooling system prevents fruits from rotting and also it kills bacteria and keeps the maker hygiene. The temperature of the cooling system can be changed according to the place. The refrigerator keeps the ice from melting.

X. PIPES

Pipes are used to transport fluids or solids from one point to another. Stainless steel pipes of grade 304 are

used. Food process services mostly use stainless steel pipes because of its factors such as durability, affordable, corrosion-resistant, reusable and easy to clean. PVC Pipes are not used here as it is not rated for use for drinking water. Pipes of diameter 50mm are used to transport solid substances such as fruits, vegetables and ice. Pipes of diameter 25mm are used to transport fluids such as sugar solution, milk and water. After each successful batch of preparation pipes are cleansed by using water.



XI. CONTAINER:

Containers are used to store fruits, vegetables, milk, ice, water and sugar solution. Food grade plastic containers are used to store fruits, vegetables, ice and milk. High quality Polypropylene food grade containers are used as it considered one of the safest among the commercial plastics available on the market today. Copper containers are used to store water as it creates a natural purification process. It can kill all the microorganisms, moulds, fungi, algae and bacteria present in the water that could be harmful to the body and make the water perfectly fit for drinking. Using copper containers water can be preserved for longer periods of time.

XII. BLENDER

Blenders are used to grind semi-solid ingredients such as fruits and vegetables to make fresh juice. It is also used to blend milk to make milkshakes. Nutribullet pro blender is used as it is compact and easy to use. This blender is powered by a 1000 watt motor which makes juices real quick thus saving time. It is a handy countertop appliance which can prepare large volumes of juice in a single blend. Countertop appliance is used here as it is easy to maintain and requires less storage space. Two or more blenders will be used to prepare multiple juices at the same time. Blenders are cleansed regularly by using water after every juice preparation.



FIGURE: NUTRIBULLET BLENDER

XIII. FILTERS

The significant part of the system are filters. Filters act as an important component in juice makers by removing all those unwanted particles thus maintaining the fresh quality of the juice. The juice extracted from the blender pass on to the filter which entrap the unwanted particles letting the fresh juice pass through the copper container. We use cross flow microfiltration(filter) which is known to be the best known filtration method for this system. Cross filtration is when the flow is applied tangentially across the membrane surface. As feed flows across the membrane surface, filtrate passes through while concentrate accumulates at the opposite end of the membrane. The only advantage over normal filters is that in normal filters they suspend only the larger particles but the filter used above will suspend even the normal particles. The filtered juice then reaches the copper container.

XIV. CUPS

The juice stored in the container is then allowed access by the customers by serving them in compostable cups. compostable cups and lids are a more sustainable option than standard paper or card single-use cups, they are only truly better for the environment if they are processed correctly. The cups are packed and sealed tightly to avoid air bubbles. A cup that is commercially compostable will breakdown at much quicker speeds - often around 12 weeks. The reason why we prefer these cups over plastic and other paper cups is that paper cups are plastic lined so they don't soak in the liquid you put in them whereas these plastic cups will remain in our landfills and pollute our environment thus we prefer sealed compostable cups over those cups



FIGURE: COMPOSTABLE CUPS

XV. DISPLAY UNIT

It is of touch screen prototype. The home screen of this system is given below (figure 1). When you press place order, it takes the customer to the next screen that is customer’s detail (figure 2).



FIGURE 1: HOME SCREEN OF THE SYSTEM

In this the customer need to enter his/her name and contact number, then press next. It takes the customer to the next screen that is list of juice (figure 3).

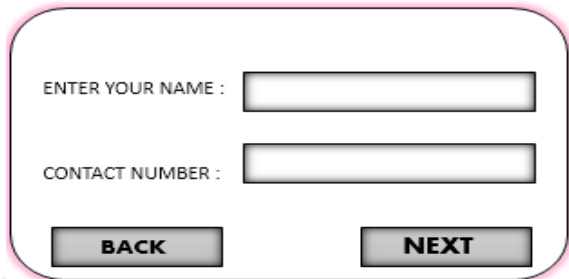


FIGURE 2: CUSTOMER’S DETAILS SCREEN

In this the customer can select what fruit juice, quantity, sugar level chillness, with or without milk (juice/shake) he/she wants. If you missed any of the column means it takes the default choice of that column. At the right most side the total amount will be displayed based on what fruit juice/shake he/she has selected. After all the selection when you press next it takes the customer to the next page that is confirmation screen (figure 4).



FIGURE 3: LIST OF JUICEAND ITS CUSTOMIZATION SCREEN

In this it shows what and all you selected in the previous screen, incase if you want to change anything you can press back it takes you to the previous screen (figure 3). When you press next it takes you to the next screen that is payment mode screen (figure 5).

XVI. TECHNICAL FLOW

When the user wants to use this autonomous juicer, he/she has to interact with an to touch screen based software which runs on microcontroller. we first welcome the customer, by clicking next in that app they would be able to place order .Here the user can select milkshake or juice . Since nowadays it has become so common that people consume food which are not healthy which could lead to excessive weight gain, diabetes, heart problems. In our solution we have provided a way to tackle this issue . When the user is ready to place an order first they have to choose whether they want milkshake or normal juice with or without ice then in the next step user has options either they could leave all as defaults in their order or they could choose how much ice ,sugar ,milk they need , this option could be really useful for health conscious people, nutritionist, bodybuilders, if the user feels this method is difficult they could also use answer few questions regarding their health, amount of sugar and milk they needed. After choosing their requirements they can proceed to pay through their digital currency or offline method. when the payment is successful 100g of fruits will be used in all juices,(see figure 2)then as per the requirement specified sugar ,ice ,milk will be added to the mixer . After mixed using a filter the solid waste will be collected and removed . then juice/milkshake can collected in paper cup.

XVII. BUSINESS IMPACT

The time taken by the system to give the output is reduced by 50% thus no manpower is essential. The system is compact thus easy to fit in any area of occupation. The quality and hygiene of the juice is also high thus maintaining 100% accuracy. The blender minimizes oxidation by rapidly absorbing air while carefully and gently mixing ingredients. Because of this, fruits are maintained optimally fresh and the original taste while blending and nutrients of ingredients are preserved. It allows users to enjoy fresh, tasty and healthy juices. Its slow-speed gentle pressure technology ensure juice quality with maximum nutritional intake, without altering fruit benefits and with minimal taste. Another great advantage is that the system can indicate the required level of sugar to be added and the required coldness level.

XVIII. MARKET SIZE

The autonomous juice makers market size is estimated to be around 7 billion in the global population (all across the world). All can access the system with ease. The uniqueness of our system is that based on different regions the method of juice can also be varied. These juicers are gaining prominence due to the adoption of smart connectivity as they can be controlled using a mobile app and enable users to access drink recipes. In addition, smart juicers offer several features, such as mobile app control, drink recipes, the ability to extract the juice directly into a variety of glass and container sizes and an adjustable mode according to the type of fruit or vegetable being juiced. Thus, with an availability of such advanced functionalities in smart juicers, the market for juicers is expected to showcase a positive outlook during the forecast period.

XIX. COST BENEFIT ANALYSIS:

The overall budget for the machine is as follows:

S.NO	MATERIAL	PRICE RANGE	QUANTITY
1	DISPLAY SCREEN	1000-3000	1
2	ATMEGA IC	500-1500	10
3	FORCE SENSOR/ LOAD CELLS SENSOR	2000-5000	10-15
4	SOLENOID VALVE	2000-4000	8-10
5	PUMP	500-1500	10-15
6	COPPER PIPES/ TUBES	3000-5000	10KG
7	CUPPLINGS	500-1000	AS REQUIRED
8	MIXERS/BLENDERS	4000-8000	3
9	FILTERS	300-500	3
10	CONTAINERS	1000-3000	10
11	REFRIGERATOR SYSTEM	10000-20000	1
12	CONNECTING WIRES	500-1000	AS REQUIRED
13	LABOURS	200-5000	-
14	OTHER EXPENSES	3000-6000	-

➤ **Cost of autonomous juice maker:**

The cost of our system ranges from 28,000/- to 64,500/-

➤ **Total cost of the system:**

The total cost of the system is estimated to be approximately around 46,250/-

XX. CONCLUSION

This autonomous juice maker lets you get the nutritious benefits of juicing because of its slow masticating features using its improved juicer system. The job of a juicer is primarily to extract juice from the fruit so that you will get 100% juice without having to deal with the pulp manually. The slow pressed juicer gently presses as well as squeezes

fruits and extracts the most out of the produce. Such system often yield more juice compared to the conventional extractors. So, to ensure that you drink healthy fruit juice this system seems to be very useful. we can conclude that such machines are time saving and can provide us fresh juice in a few minutes.

REFERENCES

- [1] <https://www.google.com/url?sa=i&url=https%3A%2F%2Fdepositphotos.com%2Fvector-images%2Fhappy-face.html&psig=AOvVaw2kIrMUDAAlJsILgs9Epgb3&ust=1608186753609000&source=images&cd=vfe&ved=0CAIQjRxFwoTCMCK6MPz0e0CFQAAAAdAAAAABAD>
- [2] https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcT3CxdVQ0C9RyPhE7xQA7dQfQKKUBccd3_cUWzkPflU9KKs7tUAzX1FVgCoG3NB4kiyez-jAQut&usqp=CAc
- [3] https://www.google.com/search?q=2+w+ay+solenoid+valve&tbm=isch&ved=2ahUKEwick--fuc_tAhVzkEsFHT-WD8wQ2-cCegQIABAA&oq=2+w+ay+solenoid+valve&gs_lcp=CgNpbWcQARgAMgIIADICCAAYAggAMgIIADICCAAYBggAEAcQHjIGCAAQBxAeMgYIABAHEB4yBggAEAcQHjIGCAAQBxAeOgQIABBDUJR_WOCOAWCalwFoAHAAeACAAfwFiAGbDJBCzMuMC4xLjEuNi0xmAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&scient=img&ei=e2PYX9zpIPOgrtoPv6y-4Aw&bih=657&biw=1349&hl=en#imgrc=4fbmEdXILoP9rM
- [4] https://www.google.com/search?q=solenoid+valve+&tbm=isch&ved=2ahUKEwiBliiOo8_tAhWbSisKHR4AC5IQ2-cCegQIABAA&oq=solenoid+valve+&gs_lcp=CgNpbWcQAZIECCMQJzICCAAYAggAMgIIADICCAAYAggAMgIIADoECAAQz oGCAAQBRAeUOS_6gJY_snmAmDm0eoCaABwAHgAgAG1AYgBzgWSAQMI1LjKYAQcGAAQgAQtd3Mtd2l6LWltZ8ABAQ&scient=img&ei=REzYX4HiJZuVrQGegKyQCQ&bih=657&biw=1349&hl=en
- [5] https://www.google.com/search?sxsrf=ALeKk00uWFtVoWF--b-g6nQRW5fXZJsBg%3A1608014338642&source=hp&ei=AlrYX6LkJN3B3LUP6IOXwAM&q=difference+between+direct+acting+and+indirect+acting+in+solenoid+valve&oq=difference+between+direct+acting+and+indirect+acting+in+sol&gs_lcp=CgZwc3ktYWIQARgAMggIIRAWEB0QHjIICCEQFhAdEB46BwgjEOoCECC6BAgjECc6CAgAELEDEIMBOgIIA

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LgDYLnPA2gRcAB4AIABpgKIAdxCkgEHMjIuMz
YuOZgBAKABAAoBB2d3cy13aXqwAQo&sclient=
psy-ab

- [6] <https://circuitdigest.com/microcontroller-projects/how-to-control-solenoid-valve-using-arduino>
- [7] <https://www.yourelectricalguide.com/2019/06/strain-gauge-working-principle-load-cell-rosettes-applications.html>
- [8] https://www.google.com/search?sxsrf=ALeKk01mi9o3tTPukCxiCFmx7LU2QkDCgQ%3A1607958190021&ei=rn7XX6ddxOrPuw-H9pKwBQ&q=construction+of+strain+gauge+load+cell&oq=construction+of+strain+gauge+load+cell&gs_lcp=CgZwc3ktYWIQARgAMgUIABDJAZIGCAAQFhAeOgQIABBHOGcIABAUEIcCUJUKWLMVYKYfaABwAngAgAFziAGGA5IBAzMuMZgBAKABAAoBB2d3cy13aXrIAQjAAQE&sclient=psy-ab
- [9] <https://www.800loadcel.com/blog/basic-working-principle-of-a-strain-gauge-load-cell.html>

