A SMART SYSTEM FOR MONITORING INTRAVENOUS DRIP BOTTLES IN HEALTHCARE

A PROJECT REPORT

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in partial fulfilment for the award of

the degree of

BACHELOR IN TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

SCHOOL OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINNERING

(Accredited by NBA)

GALGOTIAS UNIVERSITY

MAY‟2020

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Abstract

The intravenous drip system in intensive care units (ICU's)/hospitals is of utmost importance, it is used in injecting medicinal fluids inside the patient's body. The monitoring of the liquid level inside the bottles is usually done manually, often due to hectic schedule the attendant is unable to stop the outflow of liquid from bottle to the patient's body when the bottle is empty due to which problems like pulmonary embolism arise, to overcome this a system is designed which enables the monitoring of the liquid level inside the bottle from a distance . In our system a weight sensor is used to detect the level of liquid, Arduino uno microcontroller is used to read the data, GSM module to send short message, NodeMCU Board to communicate over IoT for real-time monitoring, a LCD to display percentage of liquid left, a buzzer to alert when the bottle is about to be empty and a solenoid valve to close the outflow of liquid from bottle to the patient's body when bottle is completely empty.

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1. Introduction

1.1 Intravenous Therapy

Intravenous therapy (IV) is a remedy which is used to directly carry fluids into the veins; this path of injecting fluids is used by injections through a syringe at high pressure and also by drip/infusion system which uses solely the gravitational pressure.

This technique is the quickest method of conveying liquids and meds all through the body because unlike the oral route of taking suppository where before being absorbed by the body the medicine has to travel through the mouth to the digestive tract here using IV it is directly taken into circulation.

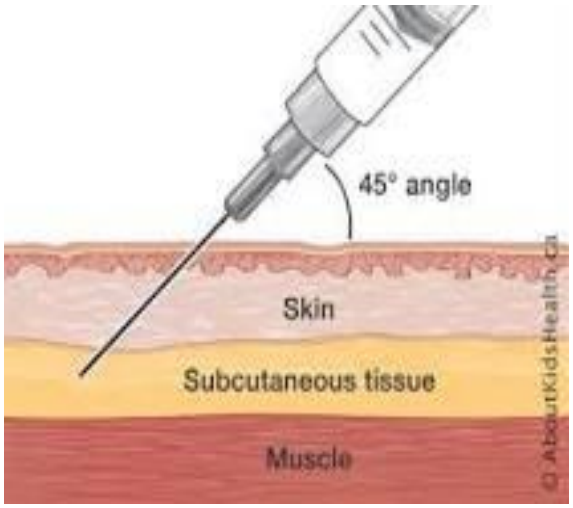


fig 1:- Injection

fig 2:- Drip system

IV therapy are used for: -

- Fluid volume replacement
- Balancing electrolytes
- Delivering medications
- Blood transfusions

I. The intravenous framework is separated as per the kind of vein the tube discharges into.

II. Peripheral lines: - It is used for the veins in arms, legs, feet, hands etc. making it the most commonly used IV therapy

fig 3:-IV for hands

III. Central lines: - The idea behind this is inserting a catheter in a vein that directly empties in a large central vein. They are used over the more common peripheral lines due to the poor accessibility towards peripheral arterial for a PIV. Another reason is when the infusion required by patients over a large period of time e.g. osteomyelitis. Another reason is when the substance like chemotherapy to be delivered damages the blood vessel linings. The damage is central veins is less compared to peripheral veins because their diameter is more compared to the latter, they have faster blood flow and is disseminated to the rest of the body faster. Medicines like vasopressors are inserted through central lines to reduce risk of extravasation.

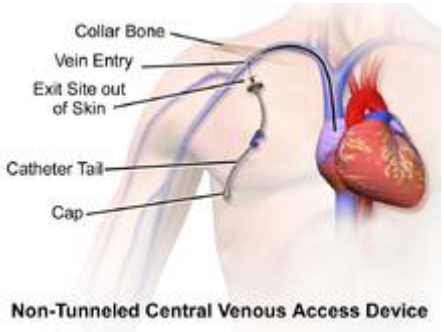


fig 4:-Central IV line

Again, the central IV technique is divided depending upon the route taken to the vein from the body

a) Peripherally inserted central catheter (PICC): - It is embedded utilizing a sheath into fringe vein with the assistance of Seldinger procedure, this is usually inserted into the arm then advanced till the right atrium.
b) Tunneled lines: - In these lines unlike inserting the catheter directly into the veins it is first passed for a certain distance through the skin this diminishes the danger of disease since microbes on skin surface don't legitimately venture out to the vein.

Fig 5:-Tunneled line

c) Implantable ports: - A port is a focal venous line that doesn't have an outer connector; rather, it has a little repository that is secured with silicone elastic and is embedded under the skin. Prescription is regulated irregularly by putting a little needle through the skin, penetrating the silicone, into the store. At the point when the needle is pulled back, the repository spread reseals itself. The spread can acknowledge many needle sticks during its lifetime. It is conceivable to leave the ports in the patient's body for a considerable length of time; if this is done, the port must be gotten to month to month and flushed with an enemy of coagulant, or the patient dangers it getting stopped up.

IV. Midline catheter: - It is inserted into the peripheral vein but does not empty into the central vein.

There are also types of infusions: -

Continuous infusion: - This is fundamentally used to address liquid and electrolytic irregular characteristics as the name says there is constant progression of medications.

Secondary IV: - Primary tubing is the one that is connected to the fluid bag that connects directly to the patient's body any other IV associated with the essential are called auxiliary/piggyback IV. Essential sack is held lower than the optional with the goal that liquid from the last can stream to the previous.

Fig 6:-IV bags on a pole

IV push: - Certain medications are given through the IV push. The syringe with the mediation is injected through the access port into the primary tubing. the syringe is pressed slowly certain medications like potassium are never delivered through this push because the spike due to this could be fatal. The liquid stream is permitted to stream regularly and consequently convey the medication into the circulatory system; in any case, a second liquid infusion is some of the time

utilized, a "flush", after the infusion to drive the medication into the circulation system all the more rapidly.

A standard implantation set comprises of a sterile compartment which permits liquid to stream each drop in turn, a sterile cylinder to control and stop the stream, a connector to join to the entrance gadget and Y-sets to permit piggybacking.

Infusion pump: - It allows control over rate of flow of medicine. The volume to be infused is usually programmed 50ml less than the capacity of IV bag.

Fig 7:-Infusion pump

Hypothermic needle: - it is an empty needle which is entered into the body.

Drip chamber: - This is used to avoid air from entering blood.

Peripheral cannula: - It consists of a short catheter inserted into the peripheral vein through the skin. An accessible vein is usually used through the arms and hands while legs and foot veins are used to a lesser extent.

A peripheral IV cannot be left inside the body as it can cause infection. However, the risks can be reduced if the IV’s are replaced routinely

Pressure bags: - On the off chance that the patient requires high stream rate rapid infuser can be used. It is either an inflatable sleeve set around the liquid sack to drive the liquid into the patient or a comparative electrical gadget that may likewise warm the liquid being injected.

There can be certain complications/adverse effects of IV therapy:

- Pain: - An injection when penetrated into the skin causes pain as it breaks it down. A condition where choice between oral and IV treatment is open like in case of dehydration oral should be opted as it is less invasive.
- Infection: - Anything breaking down the skin conveys a danger of disease in spite of the fact that IV is aseptic methodology yet at the same time skin staying living beings can enter the through the infusion site or a few microscopic organisms may enter the site through a defile catheter.
- Phlebitis: - It is inflammation of the vein due to some infection or by sheer existence of an external entity. Symptoms are warmth, swelling, pain.
- Infiltration: - Penetration happens when an IV liquid or drug unintentionally enters the encompassing tissue instead of the vein. It might happen when the vein itself breaks, when the vein is harmed during addition of the intravascular get to gadget, when the gadget isn't sited accurately, from expanded vein porosity or when the passage purpose of the gadget into the vein turns into the easiest course of action (for example on the off chance that a cannula is in a vein for quite a while, the vein may scar and close and the main path for liquid to leave is along the outside of the cannula where it enters the vein).
- Fluid over-burden: - This happens when liquids are given at a higher rate or in a bigger volume than the framework can ingest or discharge. Potential results incorporate hypertension, cardiovascular breakdown, and pneumonic edema.

- Hypothermia: - The human body is in danger of inadvertently incited hypothermia when a lot of cold liquids are injected. Fast temperature changes in the heart may hasten ventricular fibrillation.
- Electrolyte irregularity: - Administering an excessively weakened or too-concentrated arrangement can upset the patient's equalization of sodium, potassium, magnesium, chloride, and different electrolytes. Medical clinic patients for the most part get blood tests to screen these levels. It is basic to address these uneven characters in the event that they happen, as they can prompt the clinical indications of electrolyte awkwardness, which, whenever left untreated, can prompt acidosis/alkalosis, and at last passing.
- Embolism: - A blood coagulation or other strong mass, just as an air bubble, can be conveyed into the course through an IV and wind up hindering a vessel; this is called embolism. It is about difficult to infuse air through a fringe IV at a hazardous rate. The hazard is more prominent with a focal IV.
- Glucose: - Intravenous glucose is utilized in some Asian nations, for example, Korea as a shot in the arm, for "vitality," however isn't a piece of routine clinical consideration in the United States where a glucose arrangement is a doctor prescribed medication. Asian settlers to the United States are in danger in the event that they look for intravenous glucose treatment. It might be had at customer facing facade facilities taking into account Asian settlers, yet regardless of having no more impact than drinking sugared water, acts clinical dangers such like the chance of contamination. It is regularly called "ringer.

Medical uses of IV technique comprise volume expanders, blood-based items, blood substitutes, meds and sustenance.

- Volume expanders: - The two fundamental sorts of volume expanders are crystalloids and colloids. Crystalloids are arrangements of wate dissolvable particles. Colloids have huge insoluble atoms for example blood.

  Salt is the most widely recognized crystalloid strong. Colloids save a high colloid osmotic weight in the blood, while, then again, this parameter is diminished by crystalloids because of haemodilution.

- Medications: - Medications are given along with fluids so that they are easily soluble, other than the conventional approach of taking medication orally intravenous approach is good since it delivers the medicine faster. The bioavailability of the IV drug is 100%, not normal for oral prescriptions where a great part of the medicine is lost in processing before entering course.

- Blood based item: - A blood item (or blood-based item) is any segment of blood which is gathered from a contributor for use in a blood transfusion. Blood transfusions can be life-sparing in certain circumstances, for example, enormous blood misfortune because of injury, or can be utilized to supplant blood lost during medical procedure. Blood transfusions may likewise be utilized to treat a serious pallor or thrombocytopenia brought about by a blood sickness.

  Individuals with haemophilia for the most part need a substitution of coagulating factor, which is a little piece of entire blood. Individuals with sickle-cell sickness may require visit blood transfusions. Early blood transfusions comprised of entire blood, yet current clinical practice ordinarily utilizes just parts of the blood, for example, new solidified plasma or cryoprecipitate.

  Blood substitutes (likewise called 'counterfeit blood' or 'blood proxies') are fake substances planning to give a choice to blood-based items

procured from contributors. The primary blood substitutes utilized today are volume expanders, for example, crystalloids and colloids referenced previously. Additionally, 'oxygen-conveying substitutes' are developing.

- Buffer arrangement: - Buffer arrangements are utilized to address acidosis or alkalosis. Lactated Ringer's answer likewise makes them cradle impact. An answer all the more explicitly utilized for buffering reason for existing is intravenous sodium bicarbonate.
- Nutrition: -Parenteral sustenance is taking care of an individual intravenously, bypassing the standard procedure of eating and absorption. The individual gets nourishing recipes containing salts, glucose, amino acids, lipids and included nutrients.

1.2 INTRAVENOUS FLUID REGULATION

As the name says intravenous fluid regulation is controlling the amount of fluid entering the bloodstream the fluid s given from an IV line. Fluids are delivered for various reasons, if they are not controlled by some external means they are under complete influence of gravity which may result in either too much or too little flow of liquid. The flow in IV is regulated either manually or using electric pumps

Reasons for using intravenous fluid administration: -

1. Rehydration s required after being dehydrated because of prolonged illness or excess activity.
2. Using antibiotics to treat infections.
3. Treatment of cancer using chemotherapy drugs.
4. Certain pain killers to manage pain.

For such treatment's fluids like electrolytes, sugars or water added with some medication are needed.

The rate and the amount of liquid depends on the medical condition, age and body size of the patient, IV regulation makes sure correct amount of fluid drips from a bag down the IV to the vein abstaining from which can result to too quick or too fast flow which may lead to complications.

The two ways of regulating the IV are manually or through electric tubes both of which require a nurse/attendant to check the flow of IV regularly.

- Manual Regulation: - The pace of liquid trickling down the IV can be regulated manually by increasing /decreasing the weight put up on the IV tube by the clamp.
- Electric Pump: - The electric pump can be programmed to set the flow rate of liquid.

1.3 BASIC IV SETUP

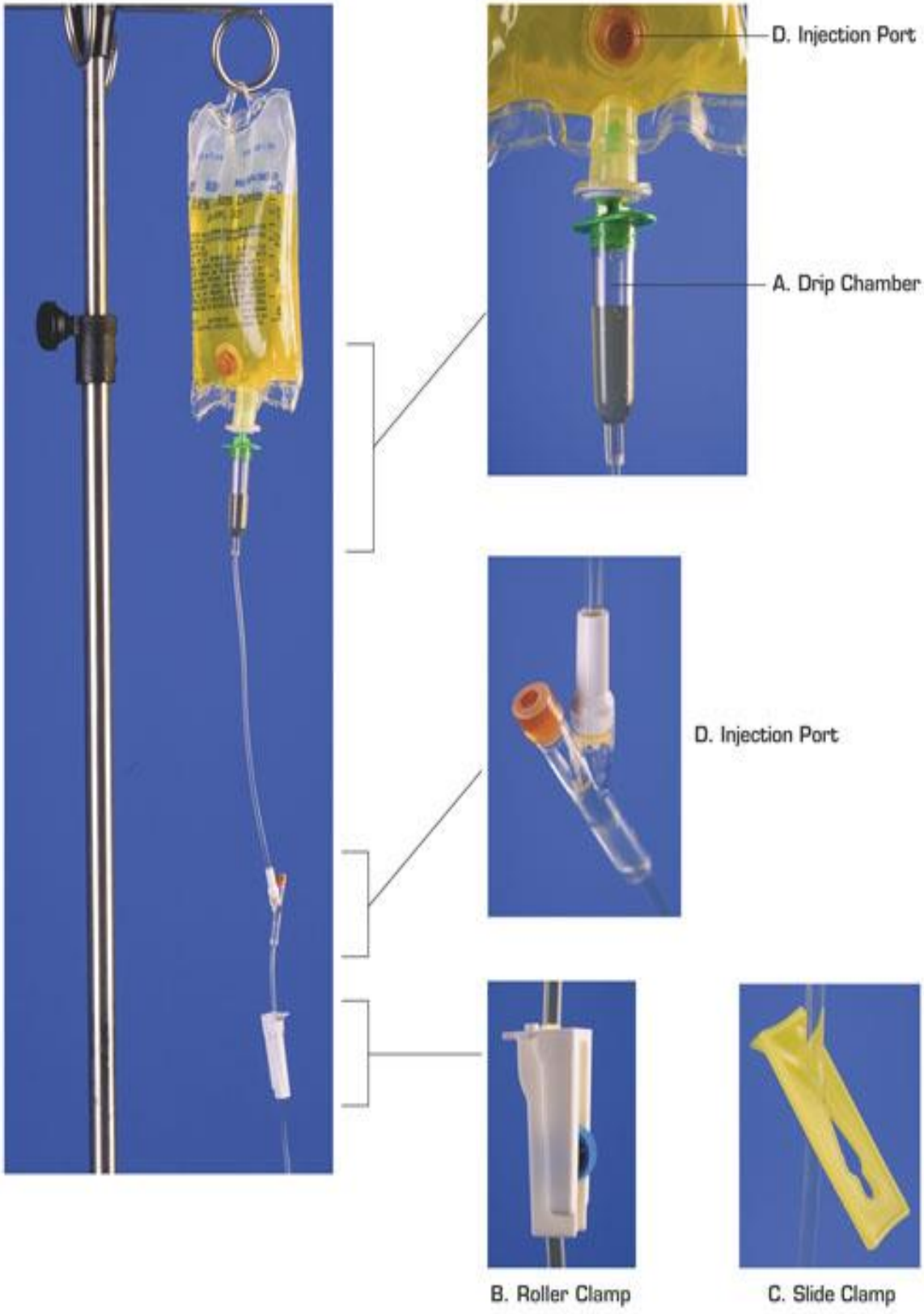


Fig 8: - Basic IV setup

Intravenous are regularly controlled by sacks of liquid that come premixed. The standard sizes of these sacks can go from 50 mL to 1000 mL. The sack is dangled from an IV post, as we find in the image above, and IV tubing is connected to the base of the pack; the IV tubing contains a few significant parts:

a. The trickle chamber is found just beneath the IV pack; inside this chamber we can see the liquid dribble down from the sack into the IV tubing. This is the place we measure the speed of a manual IV arrangement; we see this chamber and check the quantity of drops we see every moment. Along these lines, for instance, in the event that we check 25 drops over the time of 60 seconds, we would state that the IV is injecting at a pace of 25 drops for each moment, or 25 gtt/min.

The dribble chamber should consistently be half full. On the off chance that the trickle chamber is excessively full, we won't have the option to see the drops to tally them, thus we will be not able to decide the rate at which the IV is imbuing. On the off chance that the trickle chamber isn't sufficiently full, at that point this will permit air to get into the IV tubing, which implies that air would get into the patient's circulatory framework, which could be extremely perilous, hindering a vein or halting the heart.

b. The roller brace is the thing that we use to control the rate at which the IV liquid implants. On the off chance that we move it one way, it presses the IV tubing all the more firmly, making it increasingly thin and consequently making the liquid course through the tubing all the more gradually; in the event that we move it the other way, it relaxes its squeezing of the IV tubing, making the tubing less tight, and permitting the IV liquid to move through at a quicker rate. In this way, if for instance, we watch (by taking a gander at the trickle chamber and tallying drops) that an IV is implanting at a pace of 50 gtt/min, however it was requested to inject at a pace of 30

gtt/min, we would fix the roller clasp to back the dribble rate off until we could check just 30 drops experiencing the dribble chamber every moment.

c. Every IV drug will be requested to implant at a particular rate, and one of the significant errands of hospital medical attendants is to set up the IV with the goal that it injects along these same lines and to alter the IV occasionally if the rate has changed so it remains at the arranged rate. The rate at which IV liquid implants is alluded to as the IV mixture rate or stream rate.
d. The slide cinch is utilized when we need to totally prevent the IV from streaming, without altering the roller clasp. This is convenient on the off chance that we need to stop the IV for a second, however we would prefer not to need to reset the stream rate by straightening out the roller clip once more once we fire the IV up once more. This works by squeezing the tubing totally shut when we slide the tubing into the tightest piece of the cinch.

e. The infusion port is where medication or liquids other than those in the present IV pack can be infused with the goal that they will implant into the patient's vein through the IV tubing.

2. LITERATURE REVIEW

The work presented by Cheng-Ta Chiang [1] demonstrates a CMOS fluid level to recurrence converter with alignment circuits for distinguishing fluid degree of intravenous dribble. An additive innovation to this idea is that the outputs are directly digitized so that their transmission could be possible directly over radio, IR sensors, ultrasonic sensors, PSN etc. Also, a calibration technique used here, before performing adjustment the most extreme straight mistake is 46.44% and post performing adjustment it's reduced to 2.04%. The chip which is proposed is suitable for spotting fluid levels of arterial liquids.

This article investigates [2] the system used power line communication device and telemetry intravenous drip monitoring system an additional LAN network is not required for data communication, using PLC the costs were reduced by using already formed power grids. Additionally, a wireless capacitive sensor was used to detect the remaining amount of IV set, and for transmission of result by RF communication microcontroller was used.

This article [3] displays a microwave reflectometry-based framework utilized for ongoing observing and programmed control of stream of fluid in intravenous clinical implantations. the framework is planned for going around some ordinary downsides getting from the optical detecting, in this manner permitting a proficient elective answer for consequently observing the prompt progression of intravenous clinical arrangements. To this reason, the proposed framework consolidates microwave time space reflectometry (TDR) estimations with a non-obtrusive detecting component (i.e.: strip anodes straightforwardly joined to the outer surface of the mixture bottle). The outcomes accomplished show that through minimal effort versatile TDR gadgets stream control can be accomplished.

Extravasation (spillage of fluid out of a holder) is a typical danger in intravenous (IV) treatment; newborn children (0 to 2 years matured) are at high hazard. Be that as it may, in clinical work on, nursing staff are liable for checking the infusion status routinely [4], which prompts the danger of deferred treatment of extravasation of IV treatment in kids. In this investigation, we propose a sensor-combination detecting framework to identify the early indications of extravasation. Sensor combination makes up for the constraint of utilizing a solitary sensor, broadens the estimation run, and is progressively impervious to ecological obstruction. We structure a test stage to reenact the event of extravasation and, through this exhibit, show the points of interest and achievability of the proposed idea of utilizing half and half sensors.

The article [5] investigates a RFID based admonition arrangement of coming up short on infusion liquid for medical caretakers a RFID tag is structured and appended on a sack of intravenous dribble to exhibit the advantages in the current framework. The principle thought of this framework is that, tag is impaired when the pack isn't vacant in view of the EM stacking because of the fluid contained. The pack can be any sort in the present market and be with no electronic connection or change. LAN (Local Area Network) is additionally applied as a piece of this framework for information transmission.

Intravenous (IV) dribble is a urgent mode for conveyance of liquids and other pharmacological substances straightforwardly into the blood flow. IV trickle is broadly utilized on account of its focal points [6]. Regardless of the way that IV dribble is a protected, compelling and reasonable instrument, yet various inconveniences can emerge in its use. In this paper, IV dribble utilization and its related dangers are evaluated and an answer is proposed to empower checking and control of IV trickle dependent on detecting of drops falling through the dribble chamber. Such a gadget will possibly diminish complexity and give significant serenity to clients of IV trickle framework.

An intravenous (IV) imbuement checking system is worked in nursing-houses/crisis facilities. The system encourages specialists to manage the IV implantation process by planning hardware contraptions [7], creating from it a stream sack weight scale and a RFID/NFC name peruser, also an IV mixture watching programming. The microcontroller based on 6502 architecture is used as an establishment of partnering a load cell-based of s-type sensor and a RFID/NFC peruser. The pile cell changes strain, which is pulled by a spill sack, to frail the sign of electricity. The sign of electricity is improved and is dealt with into a 16-piece analog to digital converter. Finally, the strain is changed over to a two-byte propelled weight data, starting from 0 and running till 65535. The weight data of two byte and the RFID/NFC ID based data of 5 bytes are full as a data group, which is communicated by methods for UDP show to a data assimilator module of the IV blend checking system. The package is emptied and is taken care of, as demonstrated by the ID information in the group, into the patient IV implantation database. A patient IV implantation sign structure vividly illustrates all patients' IV imbuement standings on a capsule display, for instance, clinical guardians can without quite a bit of a spring read considerating IV blend information. An IV implantation notice structure sends notification of run of the mill and bizarre IV imbuement total and rate. The most colossal part of the IV imbuement checking system is that a clinical specialist drops a spill sack and presents IV implantation process short of dealing with any item boundary. The system scrutinizes spill sack weight components and RFID/NFC mark data. The structure can recognize the error of a lost stream sack by taking a gander at the RFID/NFC name data of a lifted spill pack with the patient ID. In single word, the structure enables that clinical chaperons to manage all patients' IV blend with a nonstop IV imbuement sign and a complete admonition. The structure can in like manner be changed to be used in checking drug utilization of seniors in their houses and clinical homes for serving clinical overseers manage more established people's medicine.

This paper accentuates on the control framework approach of changing over an on/off sort solenoid valve into a stage shrewd relative solenoid valve which is planned to be an outer way to deal with control the solenoid actuator positions with no alterations in the engineering of the solenoid which can give better highlights to the activity of the solenoid and makes the complete framework practical when contrasted with the corresponding solenoids accessible [8]. The framework utilizes PID with a lobby impact transducer as its input gadget. The experimentation is led utilizing 24V DC Solenoid valve and the outcomes are plotted graphically dependent on the corridor sensor yields.

This paper focuses on the issue of the exchanging misfortunes and exchanging clamor exists in the PWM vitality sparing driver circuit of rapid switch solenoid valve [9], and the issue of solenoid valve center tremor, advancing that utilizing a delicate change to comprise a driving control plan of fast solenoid valve. Utilizing the reenactment innovation to examine the delicate exchanging circuit parameters and qualities based on the examination to control exchanging gadget loss of fast exchanging esteem PWM vitality sparing drive circuit, and structuring a delicate exchanging PWM vitality sparing driver circuit constrained by MCU. The exploratory outcomes show that utilizing delicate - exchanging innovation in rapid solenoid valve driver circuit can diminish extraordinarily exchanging gadgets misfortunes and exchanging commotion, and the vitality sparing impact has been additionally improved.

Solenoid valves are the fundamental component part that generally utilized in different businesses [10]. As per the exhibition necessities of the market, it is accessible in a wide scope of shapes and size. In this paper, an enormous stream multi-stage solenoid valve has been structured and created by designing the opening, stomach and solenoid. From the outset each part has demonstrated and by joining them a virtual multi-stage solenoid valve has created lastly the accompanying outcomes have gotten from the reenactment consequences of the created model.

This paper presents the plan and improvement of a mechanized transfer controller for beat mode activity of solenoid valves for turning on/off the fuel stream to the ignition office of an engine during static test [11]. This paper counts the plan of multi-channel solenoid valve controller utilizing electro-mechanical transfers worked through microcontroller. Two application programming have been created for mechanization reason - one for synchronous activity of various solenoid valves, according to required heartbeat arrangement, created in installed C language and the other for design of the framework, created in MATLAB with a GUI. The exhibition of the structured framework has been assessed through different tests completed in lab, field and during static tests.

As the most key pieces of pneumatic Antilock Braking System (ABS) for business vehicle, the dynamic attributes of pneumatic ABS [12] solenoid valve straightforwardly impact on the viability of ABS. Displaying and recreation of pneumatic ABS solenoid valve is introduced in this paper on the highest point of MATLAB/SIMULINK, Hardware on top of it (HIL) proving ground of pneumatic ABS is created, and the trial of dynamic attributes of pneumatic ABS solenoid valve is finished. In view of the aftereffects of reenactment and test, the components which impact the dynamic attributes of solenoid valve is investigated, and the plan rule of solenoid valve is presented.

The principle motivation behind this paper is to explore the dynamic attributes of the solenoid valve in an air powered brake framework and therefore to diminish the reaction time [13]. To understand the target, this exploration presents the turn of events and approval of an expository unique model of a solenoid valve in a business vehicle, which is built up inside the multi-area physical displaying. An exploratory test rig is actualized and the trial information of the transient weight are estimated to check the model precision. The recreation and the examination results are contrasted with accomplish the appropriate parameter arrangement for the valve.

Point of this paper is to examine about force nature of the AC framework, which has become an incredible worry because of the quickly expanded utilization of inductive burdens, electronic gear (Linear and Non direct burden) [14]. We are squandering a piece of the electrical vitality regularly because of the slacking power factor in the inductive burdens which is utilized in the framework. Subsequently, there is a pressing need to maintain a strategic distance from this wastage of vitality, lower power factor and receptive force brings about poor unwavering quality, security issues and high vitality cost. The force factor of intensity framework is persistently changing because of contrasts in the size and number of the gear being utilized at once. This makes it trying to adjust the inductive and capacitive loads persistently. Many control techniques for the Power Factor Correction (PFC) were proposed. This paper presents a computationally exact procedure to plan and advancement of a solitary stage just as three stage power factor revision, receptive force and THD pay utilizing Arduino Uno small scale controlling chip. The equipment execution is created by utilizing Arduino Uno board.

The primary goal of this paper is to structure and actualize a remote detecting based house automation outline based on Arduino Uno Kit as a principle controller for this plan [15]. The proposed framework has two operational situations. The main situation is to control the home gadgets from anyplace by utilizing an advanced mobile phone with remote sensors and web innovations controlling by the client, it is named a manual-situation. The subsequent situation is to screen and control the home gadgets by a programmed administration between the remote sensors and the primary controller Arduino Uno Kit', it is called a programmed situation. To make and simple arrangement for a client the Matlab GUI stage is planned as a decent interface to control and screen the framework. The proposed framework is demonstrated to be a basic, practical and adaptable that making it a reasonable and a decent contender for the keen home future.

In this article the use of Potassium sodium tartrate tetrahydrate (KNaC4O6.4H2O) as a sensor for piezoelectric for proficient brilliant vitality sparing frameworks [16]. The characteristics of piezo effects of Potassium sodium tartrate tetrahydrate tried for various designs have been examined and the most ideal course of action has been anticipated for weight detecting by microcontroller uno. The Potassium sodium tartrate tetrahydrate precious stones have been orchestrated, changed over to crushed structure also formed in reasonable arrangement productive for weight detecting applications. The anticipated Rochelle arrangement contains 26gms of Potassium sodium tartrate tetrahydrate stuffed in round and hollow protecting container of extent 11.4cm by 5cm utilizing copper aluminum as cathode mix equipped for creating the greatest yield potential difference of 391mV, that is sufficiently adequate for detection by microcontroller uno. The discussed course of action is being utilized for proficient vitality sparing submissions in burrows, spans. The illuminating framework in the passage or the illuminations alongside of the extension can be turned ON when the automobile crosses the passage or cross the scaffold by introducing the projected Rochelle device on the passageway of passage or connect and has been adequately killed as the automobile crossed the passage or scaffold by utilizing microcontroller uno, hence prompting the effective vitality sparing illuminating frameworks. The model of the projected framework is being effectively evolved and tried tentatively.

In this paper another, minimal effort and effective PV analyzer has been structured utilizing the Arduino open source electronic stage for remote zones of creating nations [17]. The planned analyzer is seen to have palatable precision and gives profound understanding of PV clusters. The analyzer involves Arduino UNO, light sensor, temperature sensor, voltage sensor and current sensor. It was tried for different financially accessible PV boards of various kinds and sizes. The got outcomes are dependable and have practically identical execution to the industrially accessible PV analyzers. This PV analyzer is of unique enthusiasm

for sunlight-based vitality research and application in creating locales, as it is both financially savvy and open source. It tends to be adjusted by the requests of the venture. The subtleties of the analyzer's segments and execution are depicted.

In this paper [18], Arduino based Smart Irrigation System utilizing GSM Module and Sun Tracking Solar framework has been investigated. This framework is would have liked to be helpful and reasonable for the individuals of rustic regions. The module being focused for the huge populace of the provincial area is would have liked to be a gigantic commitment to the network. To satisfy the need of proficient water system framework, this paper presents the plan and execution of a minimal effort yet adaptable brilliant water system framework where with the assistance of phone the status of the submarine siphon can be watched. The plan dependent on a microcontroller UNO board where the communication in midway of the mobile phone and the microcontroller uno board is isolated. The agenda is aimed to be easy and acceptable permitting collection of devices to be measured with least differences to its centre. Along these lines the System is would have liked to beat current shrewd water system frameworks. It is accepted that this paper will assume an essential job for the provincial individuals of the immature and creating nations.

In this paper [19], a basic strategy battery charge controller has been intended to shield the battery from over-charging and profound releases. The control of the procedure is depended to Arduino Uno board, that must have the option to discover the battery state and decide when the charge procedure must be done. The condition of the battery is splendidly controlled constantly. The utilization of an Arduino Uno dependent on microcontroller has been considered so as to permit a decent adaptability, to streamline the equipment required (just a couple of outside parts are utilized), and to give a keen instrument to embrace, through the modified calculation. A buck DCDC Converter has been utilized to step down voltage from the board photovoltaic to charge voltage of the battery.

This paper presents an examination between the reproduction and handy acknowledgment aftereffects of the gadget. A decent understanding is gotten.

This paper primarily finishes the equipment stage and programming structure of the remote vehicle control framework [20]. Equipment stage configuration utilizing measured structure thoughts, simultaneously, utilizing ARDUINO UNO R3 module as the primary control part, ultrasonic sensor module, Bluetooth module, honey bee sound caution module, engine driver module as the fundamental modules; programming improvement and configuration utilizes ARDUINO programming to compose the principle program, understanding the vehicle Bluetooth remote control and programmed ultrasonic obstruction shirking. What's more, it likewise utilizes top-down structure thoughts. Signal alert module is plan to accomplish the programmed snag shirking when the obstructions are near the vehicle. Ultrasonic separation estimation module HC_SR04 is expect to quantify the separation of deterrents and the vehicle, and afterward to accomplish the view of snags. The Bluetooth module HC_05 is utilized to understand the correspondence between the control terminal and the control place. Engine drive module L298N for the engine drive is the main thrust for the vehicle parts.

In the zone of sustainable power source utilizes, staggered inverter despite everything stay a topic for innovative work to diminish its circuit unpredictability. Pressed U Cell (PUC) staggered inverter is an ongoing variation, widely being utilized in photovoltaic applications as a choice to meet the deficiency in power requests concentrating a lot on diminishing the establishment cost, increment framework's productivity [21], dependability and measured quality. It is essential to act to diminish this expense through structuring a force molding circuit with lower cost. To meet this goal ARDUINO UNO is utilized in producing and giving heartbeat width adjusted (PWM) signs to control the doors of Insulated Gate Bipolar Transistor (IGBT) that establish the significant structure square of PUC staggered inverter. MATLAB/Simulink is utilized being developed of the

photovoltaic framework which incorporates PV modules, Maximum Power Point Tracking (MPPT) controller, DC-DC support converter and PUC inverter. The reproduction result approves the benefits and execution of this proposed plot.

The motivation behind this examination is the structure of the water clearness observing framework in the aquarium can distinguish the degree of lucidity/turbidity of water at a specific level, utilizing Arduino Uno Microcontroller as a controlling focus [22], and LDR (Light Dependent Resistor) as a sensor. The nature of water identifying with the status of clearness during the water, progressively away from and the nature of the water is correct. Plan philosophy made utilizing a shut control framework. The plan results show that the device intended to control the lucidity of the water in the aquarium.

3. PROPOSED SYSTEM

3.1 BACKGROUND

A Smart system can monitor the flow of fluid in drip bottles and indicate the level of fluid in the bottle. Smart system is equipped with load cell. The load cell is the primary requirement of the system which helps to calculate the weight of the bottle. The load cell converts the mechanical pressure into electrical signal and sends it to the amplifier which helps to detect and amplify even the small change in weight of the bottle. The weight/information thus read is sent to the microcontroller Arduino uno. The user interface which is used to see the real time weight of the bottle is made on an app. The real time information is given via internet through the Wi-Fi module connected to Arduino. However, the app must require a Login ID and password for security reasons. The alert is sent through GSM module connected to Arduino. GSM module send alert message to the mobile number codded in Arduino through Arduino IDE.in this way we can monitor the weight of the bottle connected via internet. The working

of the project is simple we just monitoring smart bottle through an application using internet.

Arduino is connected with Wi-Fi module; GSM module and Load amplifier Wi-Fi module helps to connect with the application. When bottle weight is below 100ml, GSM module send the alert message to provided mobile number and Buzzer produce alert sound. Next using the Blynk application in mobile we have used an application to real time monitor weight of the bottle via internet.

Also, in worst case scenario if the attendant is unable to close the outflow from the bottle a solenoid valve is placed which automatically cuts off the flow once the bottle is completely empty.

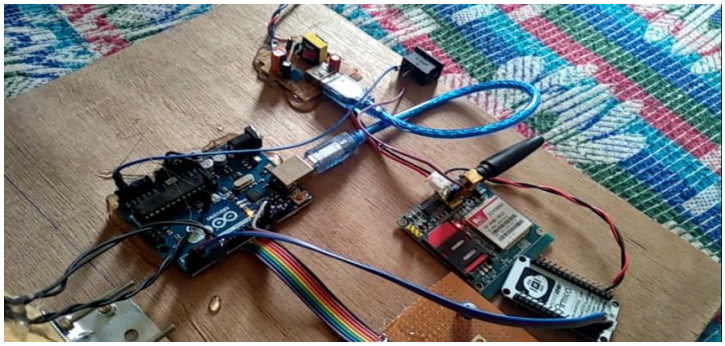


Fig 9: -component setup

3.2 BLOCK DIAGRAM

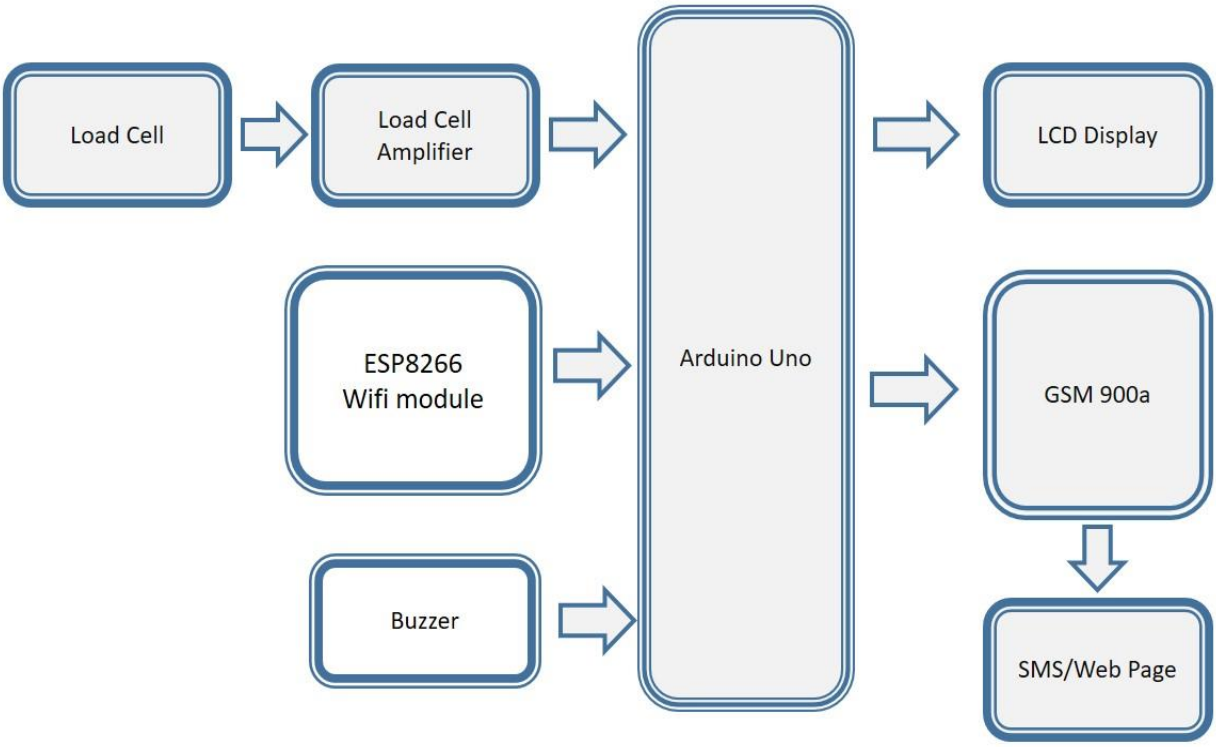


Fig 10: -Block diagram of the project

3.3 HARDWARE TOOLS USED: -

3.3.1 Load cell: - A weight sensor also known as load cell is a sort of device which converts one form of energy to another, in much more clear manner it changes weight energy to other forms. The conversion of mechanical power, for example, strain, pressure, weight, or torque into an electrical signal which can be easily read and understood is the principal function of a weight sensor. The signal received in electrical form changes in accordance to the weight applied.

Fig 11: -Load cell

Simple Formula to measure Force: -

Measured Force = A * Measured mV/V + B (offset)

To find A: -

This load cell has a rated output of 1.0±0.15mv/v which corresponds to the sensor’s capacity of 5kg.

Capacity = A * Rated Output A = Capacity / Rated Output.

Here,

Offset = 0 - 5 * Measured Output

3.3.2 Load cell Amplifier :- Load cell amplifier is necessary because the signal coming from the load cell is too weak to read this makes it suspectable to certain noises which may further degrade it and also as per requirement of different interfaces the signal may have to undergo conditionings like isolation, linearization, filtering etc.

Fig 12: -load cell amplifier

3.3.3 Arduino UNO: - The Arduino Uno is a microcontroller board dependent on the ATmega328. It has 14 advanced info/yield pins (of which 6 can be utilized as PWM yields), 6 simple sources of info, a 16 MHz precious stone oscillator, a USB association, a force jack, an ICSP header, and a reset button. It contains everything expected to help the microcontroller; basically, associate it to a PC with a USB link or force it with an AC-to-DC connector or battery to begin. The Uno contrasts from every single going before board in that it doesn't

utilize the FTDI USB-to-sequential driver chip. Rather, it includes the Atmega8U2 modified as a USB-to-sequential converter.

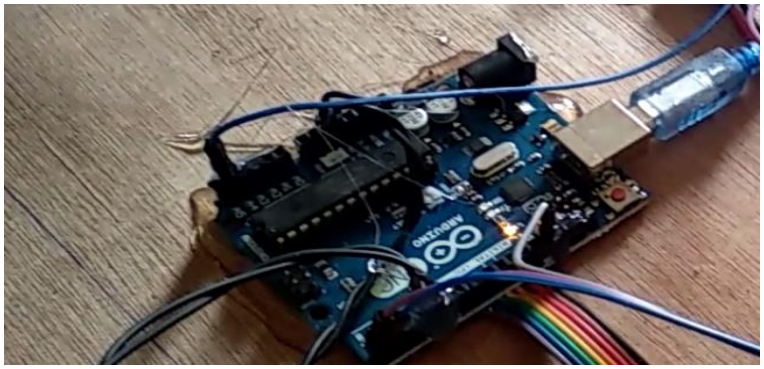


Fig 13: -Arduino Uno

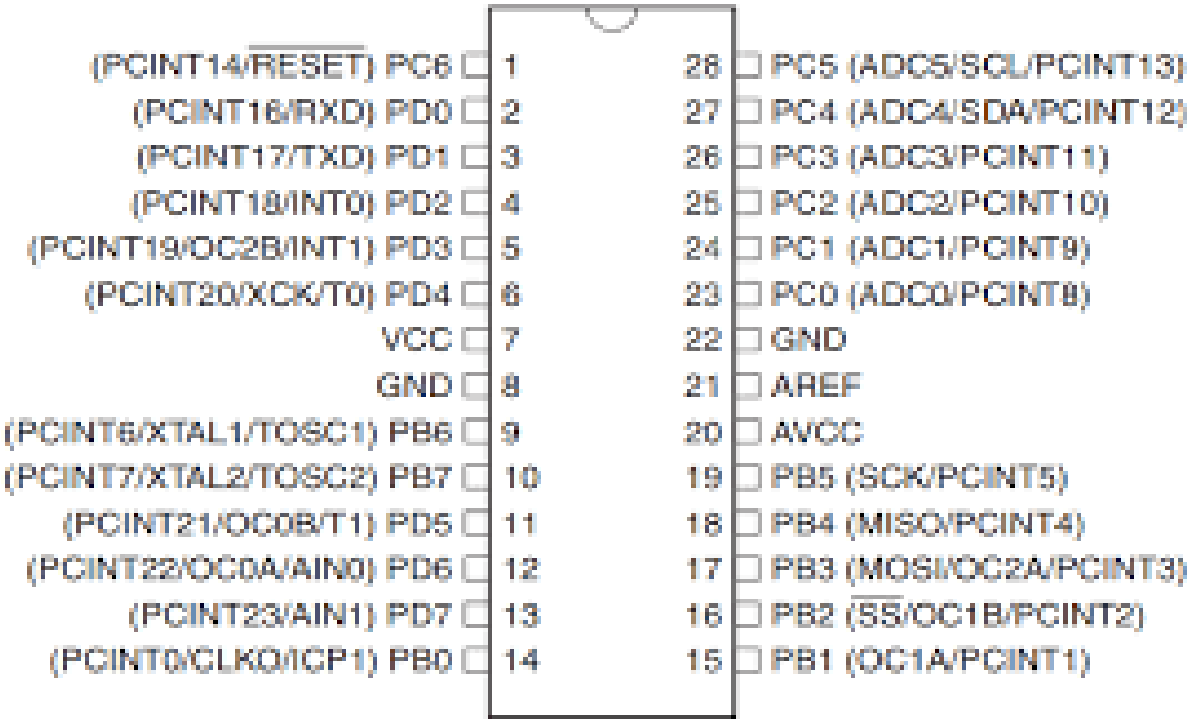


Fig 14: -UNO pin diagram

To program the Arduino Uno disconnected the Arduino Desktop IDE is required to be introduced. The Uno is customized utilizing the Arduino Software (IDE), Integrated Development Environment normal to all sheets. The USB association with the PC is important to program the board and not simply to control it up.

TECHNOLOGY	SPECIFICATION
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14
Analog input pins	6
DC current per I/O pin	40mA
DC current for 3.3V pin	50mA
Flash memory	32KB
SRAM	2KB
EEPROM	1KB
Clock Speed	16MHz

Table 1: - Arduino uno specifications

3.3.4 LCD Display: - LCD (Liquid Crystal Display) is a kind of display which makes use of liquid crystals to give rise to images. The technology used in LCD's is primarily of two types one is using matrix display of active type and other one of passive display type with grid designs.

Fig 15: -LCD display

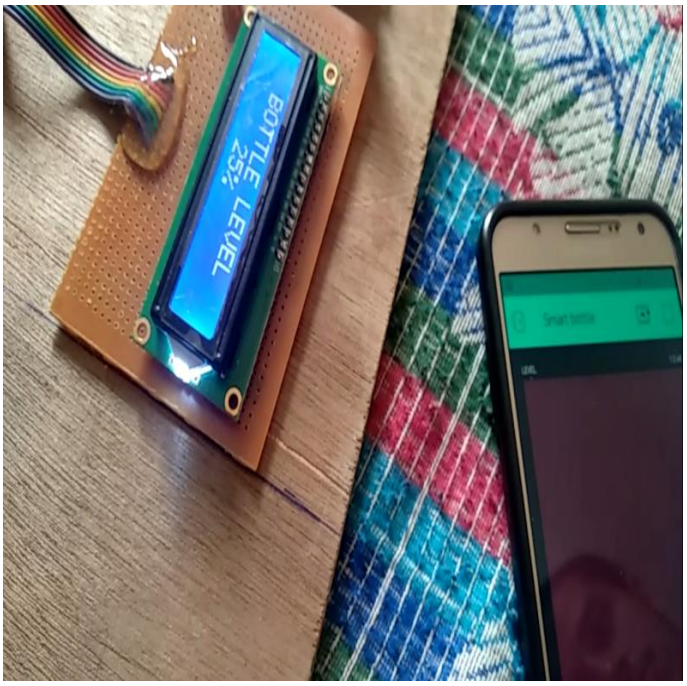


Fig 16: -LCD display indicating bottle level

3.3.5 GSM900a: -

The global system for mobile communication module which is discussed below is an extreme-minimal and compact distant component. The device is a complete Twin-band GSM/GPRS planning inside of surface mount technology unit that is fitted in the user bids. The device has an interface which is compatible with the market standards, the one that transports GSM/GPRS 900/1800MHz finishing for voice, SMS, Data, and Fax with a smaller construction feature also including fewer force consumption. The device appropriates almost everywhere the user bids, especially for thin and lower concentration of plot.

Fig 17: -SIM 900a

The SIM900A is a promptly accessible GSM/GPRS module, utilized in numerous cell phones and PDA. The module can likewise be utilized for creating IOT (Internet of Things) and Embedded Applications. SIM900A is a double band GSM/GPRS motor that chips away at frequencies EGSM 900MHz and DCS 1800MHz

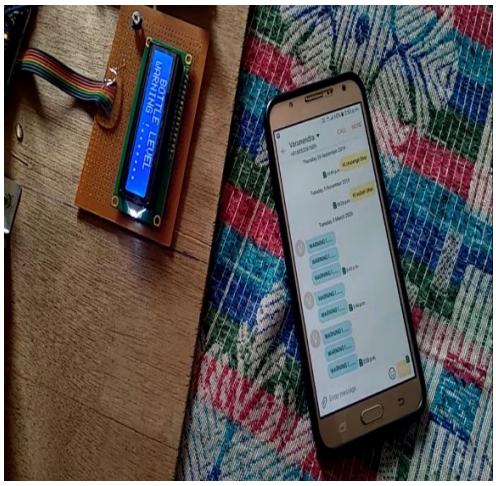


Fig 18: -SIM900a sends alert message

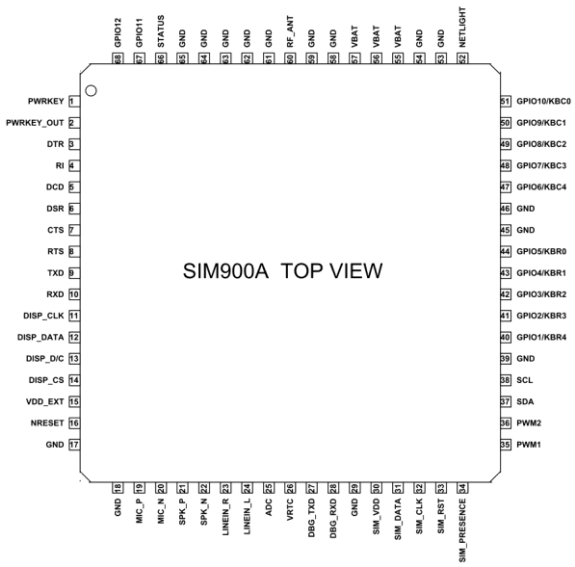


Fig 19: -SIM900a top view

Feature	Implementation
Power supply	Single supply voltage 3.4V-4.5V
Power saving	Typical power consumption in sleep mode is 1.5mA
Frequency band	Dual band- EGSM900, DCS1800
GSM class	Small MS
Transmitting power	Class 4(2W) at EGSM900 Class 1(1W) at DCS1800
GPRS connectivity	GPRS multi slot class10 GPRS multi slot class 8 GPRS mobile station class B
Temperature range	30 to 90 Degree Celsius
SMS storage	SIM card
FAX	Group 3 class 1
SIM interface	Support sim card: -1.8V,3V
External Antenna	Antenna Pad
Physical characteristics	Size: -24mm*24mm*3mm Weight: -3.4g
Real time clock	Implemented
SIM application Tool kit	Support class 3, GSM 11.14 Release 99

Table 2: - SIM 900a specification

3.3.6 Buzzer: -

A buzzer is a sound flagging gadget, which is electromechanical. Normal employments of ringers and beepers incorporate caution gadgets, clocks, and affirmation of client info, for example, a mouse snap or keystroke. The signal comprises of an outside case with two pins to connect it to power and ground.

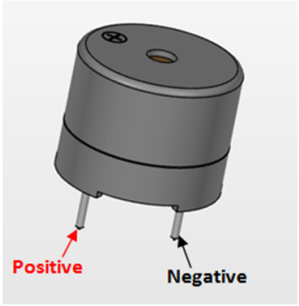


Fig 20: -Buzzer

3.3.7 ESP8266 module: -

ESP8266EX (essentially alluded to as ESP8266) is a framework on-chip which coordinates a 32-piece Ten silica microcontroller, standard computerized fringe interfaces, receiving wire switches, power amplifier, low commotion get enhancer, channels and force the executive's modules into a little bundle. It gives abilities to 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2), universally useful info/yield (16 GPIO), Inter-Integrated Circuit, simple to-computerized change (10-piece ADC), Serial Peripheral Interface (SPI), I²S interfaces with DMA (offering pins to GPIO), UART (on devoted pins, in addition to a transmit-no one but UART can be empowered on GPIO2), and heartbeat width balance (PWM).

Fig 21: - ESP8266 Wi-Fi module

The processor center, called "L106" by Espressif, depends on Tensilica's Diamond Standard 106 Micro 32-piece processor controller center and runs at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 32 KB guidance RAM, and 80 KB client information RAM. Outside blaze memory can be gotten to through SPI. The silicon chip itself is housed inside a 5 mm × 5 mm Quad Flat No-Leads bundle with 33 association cushions — 8 cushions along each side and one enormous warm/ground cushion in the jog. The ESP8266 arrangement by and by incorporates the ESP8266EX and ESP8285 chips.

APPLICATION OF ESP8266: -

1. Body monitoring
2. Wi-Fi location aware device
3. Wi-Fi position system beacons
4. Security ID tag
5. Sensor networks
6. Industrial wireless control

Items	**Values**
Certification	FCC/CC/TELEC/SRRC
Wifi protocol	802.11 b/g/n
Frequency Range	2.4G-2.5G
Tx power	20,17,14 dB

Rx Sensitivity	-91.-75, -72 dB
Types of Antenna	PCB Trace, External, IPEX connector, Ceramic chip

Table 3: -ESP8266 module specification

3.3.8 Solenoid valves system: -

A solenoid valve is one which interprets electrical commands to execute mechanical task, the customary application of this device is with stopping/controlling the flow of fluids and gases. Diversifications of the same are many but the fundamental variations are the command driven ones and the straight approached ones. Command driven valves, the most broadly utilized, use framework line strain to lock and unlock primary hole in the device framework. The straight worked ones legitimately lock and unlock the primary device hole, that is the principal path through the device. They are utilized in frameworks in need of lower stream limits or execution along lower weight variance over the device opening.

These devices work through regulatory progression of fluids or gases in a positive, completely shut or completely open mode. They are much of the time used to exchange manual valves or for remote control. This devices work includes cracking or shutting a hole in the device body, that permits or forestalls move within the device. An unclogger craks or shuts the hole by levitation or bringing down inside the sheath pipe by stimulating the curl.

The device comprises of a loop, unclogger and sheath get together. In regularly shut stopcocks, an unclogger coming back coil grips the unclogger counter to the opening as well as forestalls stream. When the device turn is stimulated, the

subsequent attractive ground rises the unclogger, empowering stream. At the point where the device turn is empowered within a typically exposed stopcock, the unclogger closes the hole, which thusly forestalls stream.

Application of Solenoid valve: -

- The controller used in gas and oil burners
- Separating a mixture of gases
- Controlling a blend of gases
- Apparatus used in examination of blood
- Governance in cleansing techniques
- Water mains protection and fire extinguishing systems

Fig 22: -Solenoid valve

3.4 Software Tools used

3.4.1 Arduino IDE: -

The Arduino Software (IDE) is utilized to compose programs and transfer them to board. In the Arduino Software page, there are two alternatives:

1.If web association is accessible online Arduino IDE is utilized it permits the client to spare the records in the cloud so they can be utilized later on.

2. For disconnected reason, work area IDE is valuable.

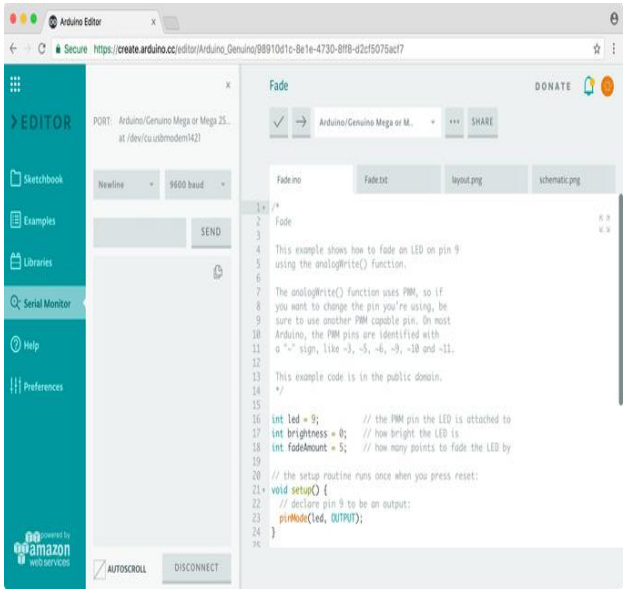


Fig 23: -Arduino Web Editor

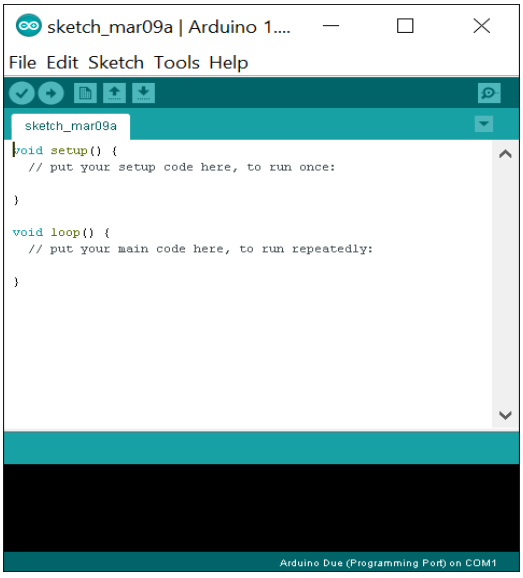


Fig 24: -Arduino IDE

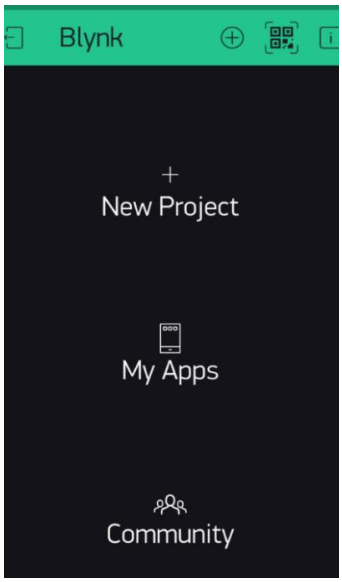
3.4.2 Blynk app: -

Blynk is a Platform with IOS and Android applications to control Arduino by means of Internet. It's an advanced dashboard where you can fabricate a realistic interface for your venture by basically relocating gadgets. Blynk application have many equipment models and association types. Select the Hardware type. After this, select association type. In this undertaking we have select Wi-Fi network. Blynk is a Platform with IOS and Android applications to control Arduino, Raspberry Pi and the preferences over the Internet. It's a computerized dashboard where you can fabricate a realistic interface for your venture by just moving gadgets.

Setting up Blynk application: -

In the wake of downloading the application, make a record and sign in. You'll additionally need to introduce the Blynk Arduino Library, which produces the firmware running on your ESP8266. Snap the "Make New Project" in the application to make another Blynk application. Give it any name. Blynk works with many equipment models and association types. Select the Hardware type.

After this, select association type. In this task we have select Wi-Fi availability.



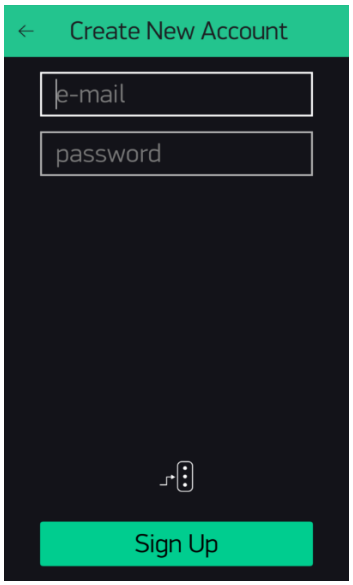
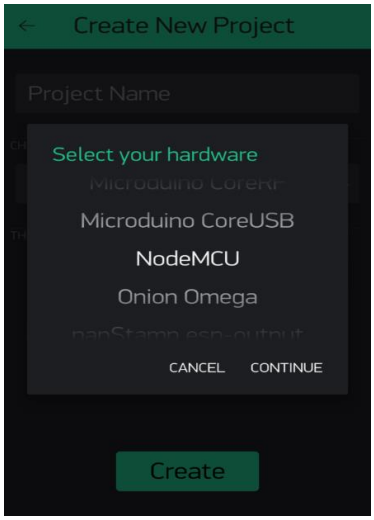


Fig 25: - Blynk application

Fig 26: -create account

Then you'll be presented with a blank new project. To open the widget box, click in the project window to open,

1. Click on Bottle.
2. Give name to Bottle say Smart bottle.
3. Under OUTPUT tab- Click pin and select the pin to which Wi-Fi module is connected to Arduino.



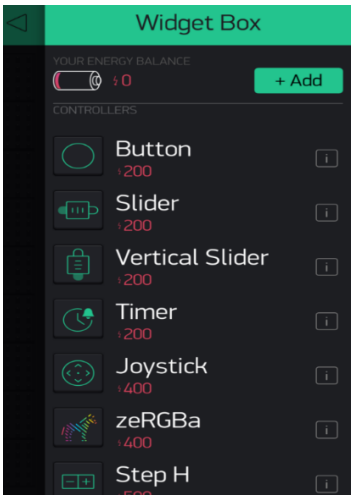


Fig 27: -Hardware selection

Fig 28: -Select bottle

4.RESULTS AND DISCUSSIONS

The components and circuitry used in the suggested system are thoroughly tested individually before amalgamating them and executing the entire system as a whole. The load cell gives an output voltage variable from 0-5mV. The HX711 amplifier is also tested. The Arduino uno board is run individually & tested successfully on the IDE by supplying certain voltages to the analog pin furthermore the first sub circuitry is verified by hanging a load on the load cell and feeding program to the microcontroller before reading and displaying the load.

The GSM is used to send message over the 900/1800 MHZ frequency range. It is tested by connecting it to the transmitter and receiver pins of the Arduino and inserting a SIM then IDE is used to send message to the respective mobile number which upon receiving the message verifies the communication. The ESP8266 just like any other Wi-Fi module is used for communicating over the internet it is also verified with Arduino microcontroller by connecting it with an app and sending data.

Next component is the buzzer which has a simple test of connecting it to the battery and it starts buzzing. The solenoid valve is tested using a multimeter by connecting the two wires one to the center of the body of the valve and other to the top of it any coil has a certain resistance but if its shorted its resistance will be zero.

After all the components are successfully tested and the sub parts are also verified the whole system is ready to run. The load cell is hung from a wooden log the amplifier is directly attached to it the corresponding connections are made with the Arduino, a separate module dedicated to the power supply is developed and connected. Finally, the system is run by hanging the liquid bottle to the load cell and correct data is read and communicated with the attendant.

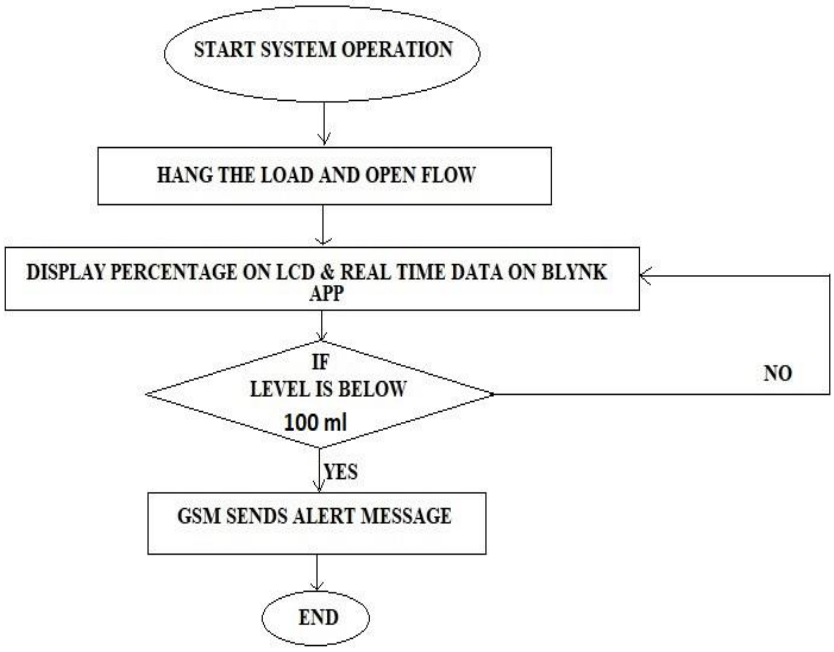


Fig 29: - Overall working flowchart of the system

The schema chart shown above demonstrates the working of the system step by step.

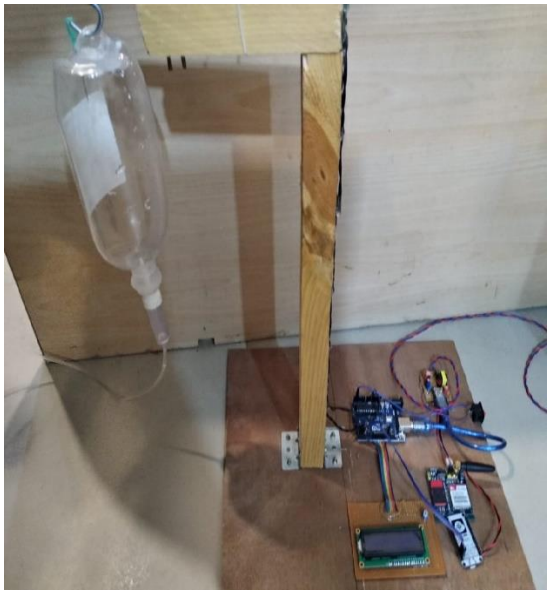


Fig 30:- Stage 1

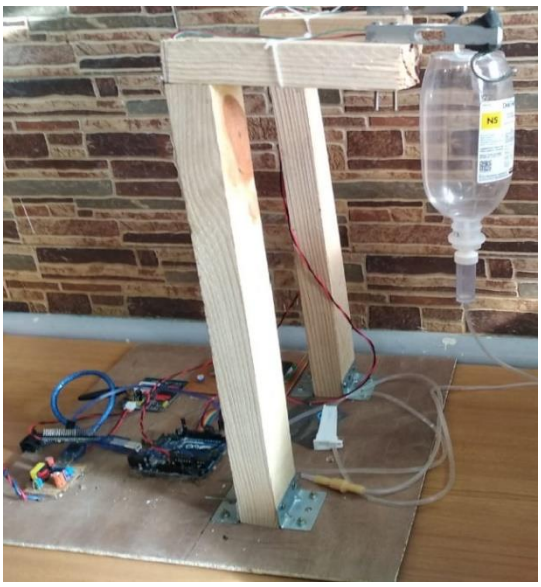


fig 31:- Stage 2

The above figures donate the subsequent stages of the development of system.

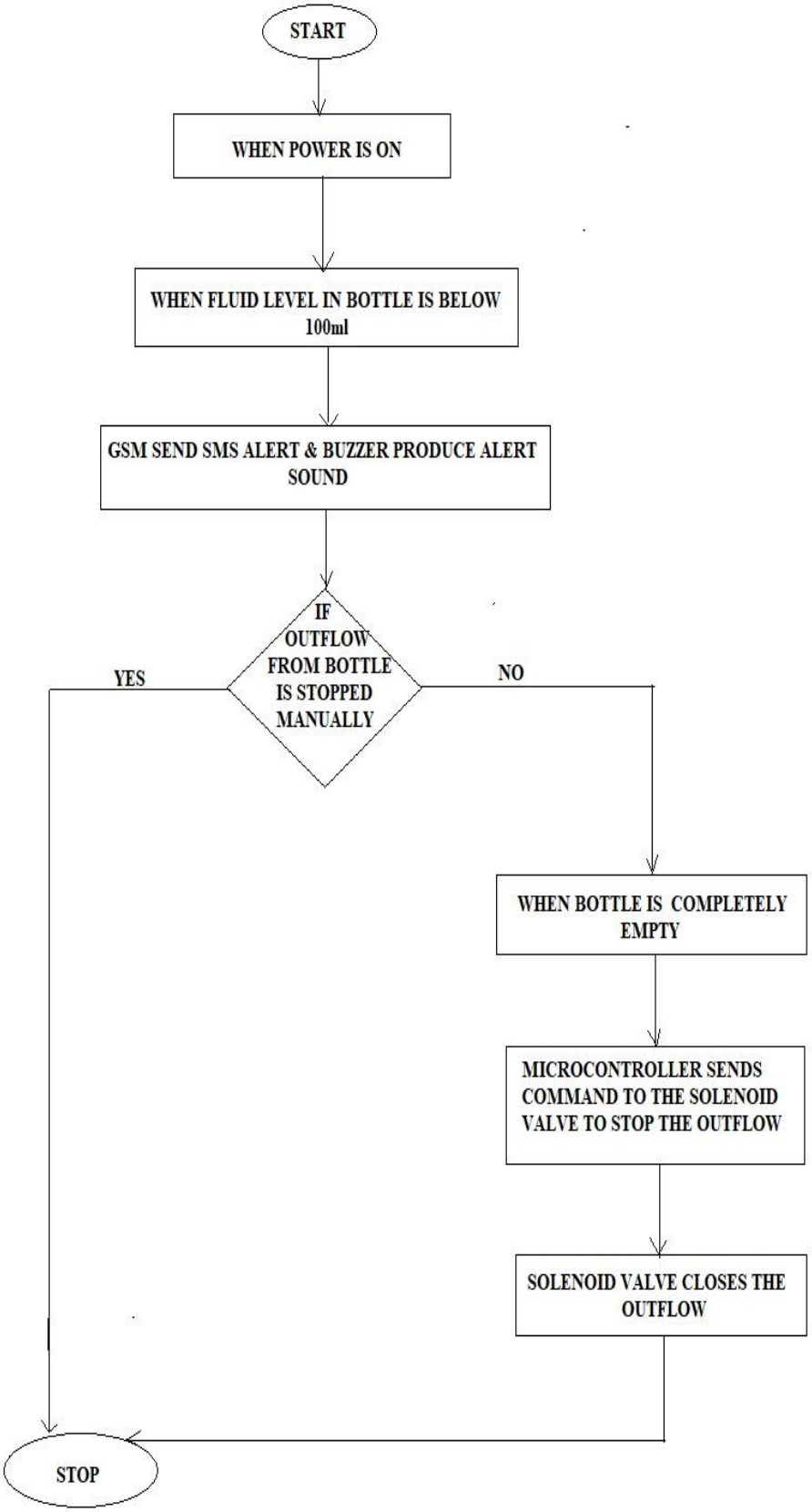


Fig 32: - The operating flowchart for solenoid valve

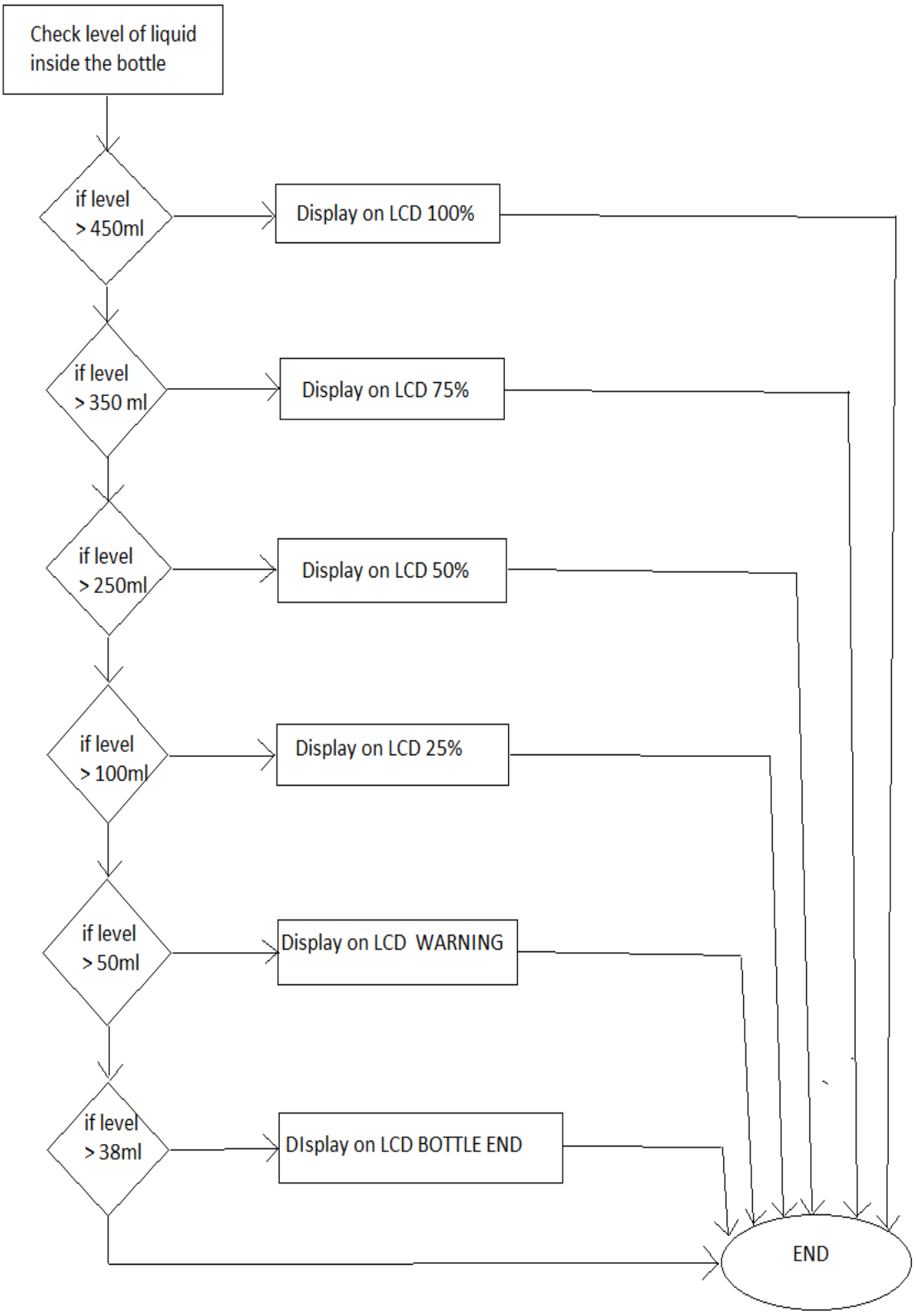


Fig 33: - Working flowchart of percentage of liquid level displayed on LCD

The above results for the display of percentage level liquid on LCD are verified

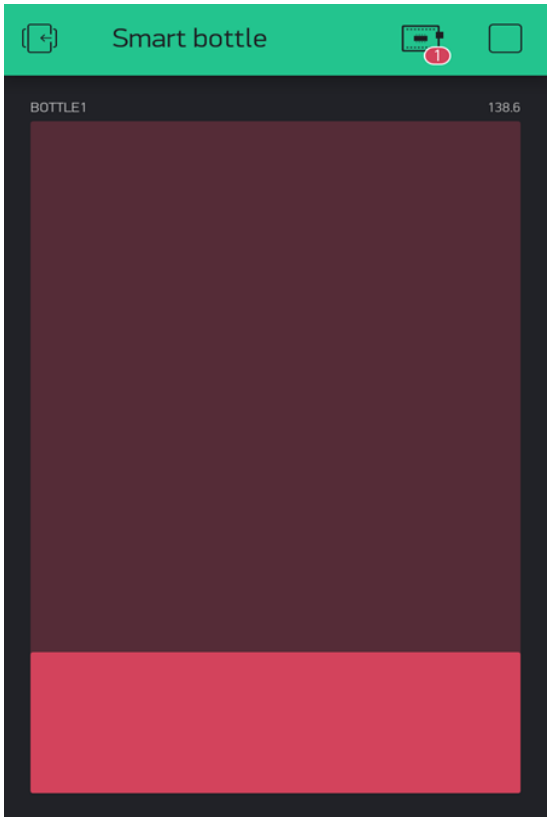


Fig 34: -Stage 1 Blynk app

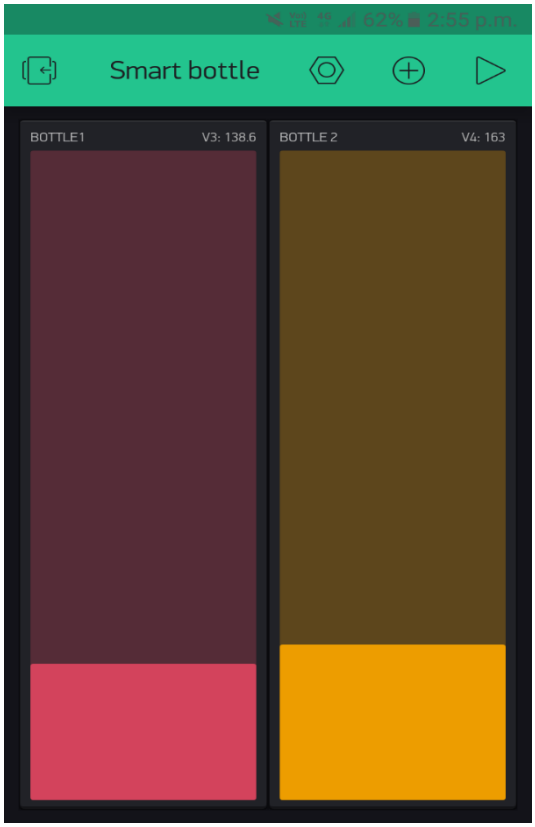


Fig 35: - Stage 2 Blynk app

The interface of the Blynk app for single as well as two bottles is shown above.

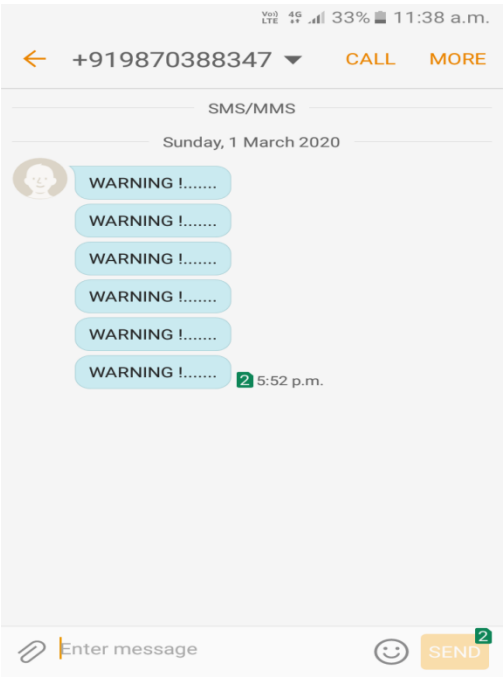


Fig 36: - Alert message

5. CONCLUSION

In this report the implementation of smart bottle monitoring system with the help of load cell, Wi-Fi module, GSM module and Arduino are described. The operative of the system and associated risks are discussed. The bottle is monitored by Blynk application and the information transferred from load cell to the app via Wi-Fi module. The GSM module is used to send the alert message to the provided mobile number when the water level is below 100 ml in every 10 second. LCD shows the level of water in the bottle in terms of percentage. This is very easy implementation straight forward method to reduce the chance of patient hazard. Our arrangement assimilates a lot of features of the prevailing systems and also adds on new features to it which upgrade the performance of the system by many margins.

With this new found knowledge simple user interface is formed for real time monitoring of not only one patient but many patients with the help of Arduino IDE we been able to provide the number for alerting nurses and Arduino help to handle all the information transaction at a time.

ADVANTAGE

1. Automatic workflow
2. Minimized wastage
3. Reduce risk of error

DISADVANTAGE

1. Lack of information of patient
2. Increased cost of treatment for patients

6. FUTURE SCOPE

In this project we have been able to monitor two patients at a time but we can extend it to 10 or 20 patients at a time. It can also be connected to a display that helps us to monitor 20 patients at a time and we been able to see the level of each bottle on that display at a time with patient number. The display can be connected with wire so that the accuracy is more and no delay occurs. If we connect display with system through internet there are chances of information loss and some delay may occur.

The flow of fluid can also be controlled according to patient information provided by changing the coding part a bit. This would help the patients to recover fast and there are no side effects on the body.

We can also improve our user interface so that it is more user friendly and patients and nurses both can easily monitor level of fluid in bottle in real time.

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8. APPENDIX

Coding part for BLYNK app

```
#include <BlynkSimpleEsp8266.h>
#include <SimpleTimer.h>
#define BLYNK_PRINT Serial    // Comment this out to disable prints and save space
char auth[] = "wWJWXC_pb95ebLYNz_b6e1TLpD2ivubx";
char ssid[] = "Murali";
char pass[] = "hiram007";

char incomingByte[30] ; // for incoming serial data
String mystring;

SimpleTimer timer;
void setup()
{
  Serial.begin(9600);
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(1000L, getSendData);
}

void loop()
{
  timer.run();
  Blynk.run();

}
```

```
void getSendData()
{
  if (Serial.available() > 0)
  {
    for (byte i = 0 ; i < 10 ; i++)
    {
      while (Serial.available () == 0)
      {}

      incomingByte[i] = Serial.read();
      if(incomingByte[i] == ' ')
      {
        incomingByte[i]='\0';
        break;
      }
    }
    delay(500);
  }

  if(strlen(incomingByte) > 0)
  {
    Serial.println(atof(incomingByte));
    Blynk.virtualWrite(V3, atof(incomingByte)); //virtual pin V3

  }
}
```

CODING PART for Wi-Fi,LCD

```
#include <SoftwareSerial.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(13, 12, 11, 10, 9, 8);
const int GSM_RX = A3;  // TX
const int GSM_TX = A4;  // RX
SoftwareSerial SIM900(GSM_RX, GSM_TX);
#include <HX711_ADC.h>
#include <Wire.h>
HX711_ADC LoadCell(4, 5); // parameters: dt pin, sck pin<span data-mce-type="bookmark" style="display: inline-block; width: 0px; overflow: hidden; line-height: 0;" class="mce_SELRES_start"></span>
float i=0;
float prev_i = -10;
int prev_type = 0;

void setup()
{
  Serial.begin(9600);
  //Serial.println();
  LoadCell.begin();
  LoadCell.start(2000);
  LoadCell.setCalFactor(380.0);
  lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("   IOT Based.   ");
  lcd.setCursor(0, 1);
  lcd.print("  Smart Bottle  ");
```

```
  delay(3000);
  lcd.clear();
  SIM900.begin(9600);
  delay(2000);
  SIM900.println("AT\r");
  delay(1000);
  SIM900.println("AT+CMGF=1\r");
  delay(1000);
  SIM900.println("AT+CNMI=2,2,0,0,0\r");
  }
void SendMessage(int type)
{
  SIM900.begin(9600);
  delay(3000);
  SIM900.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);  // Delay of 1000 milli seconds or 1 second
  SIM900.println("AT+CMGS=\"+917702943629\"\r"); // Replace x with mobile
number
  delay(1000);
  if (type == 1)
  {
    SIM900.print("WARNING !.......");
    delay(500);
  }

  SIM900.println((char)26);// ASCII code of CTRL+Z
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print("SMS Sent.......");
```

```
  lcd.setCursor(0, 1);
  lcd.print("  BOTTLE LOW  ");
  delay(3000);
  lcd.clear();
}

void Level_Full()
{
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("  BOTTLE LEVEL  ");
    lcd.setCursor(0, 1);
    lcd.print("      100%      ");
    delay(100);
}

void Level_75()
{
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("  BOTTLE LEVEL  ");
    lcd.setCursor(0, 1);
    lcd.print("      75%      ");
    delay(100);
}
void Level_50()
{
   lcd.clear();
    lcd.setCursor(0, 0);
```

```
    lcd.print("  BOTTLE LEVEL  ");
    lcd.setCursor(0, 1);
    lcd.print("       50%      ");
    delay(100);
}
void Level_25()
{
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("  BOTTLE LEVEL  ");
    lcd.setCursor(0, 1);
    lcd.print("      25%       ");
    delay(100);
}
void WARNING()
{
    lcd.clear();
    lcd.setCursor(0, 0);
    lcd.print("  BOTTLE LEVEL  ");
    lcd.setCursor(0, 1);
    lcd.print("WARNING !.......");
    delay(100);
}


void loop()
{
  LoadCell.update();
  i = LoadCell.getData();
```

```
  while(abs(prev_i - i) > 5)
  {
    LoadCell.update();
    i = LoadCell.getData();
    //Serial.print("Weight[g]:");
    //Serial.println(i);
    prev_i=i;
    //delay(1000);
  }

  if ( i>450)
  {
   Level_Full() ;
  }
else if ( i> 350)
  {
     Level_75() ;
  }
 else if ( i>250)
  {
     Level_50();
   }
  else if ( i>100)
  {
    Level_25() ;
  }
  else if ( i>50)
  {
     WARNING();
```

```
    SendMessage(1);
  }
   else if ( i>38)
  {  lcd.clear();
     lcd.setCursor(0, 0);
     lcd.print("   BOTTLE END   ");
     lcd.setCursor(0, 1);
     lcd.print("    THANK YOU   ");
     delay(100);
    }
   else
  {  lcd.clear();
     lcd.setCursor(0, 0);
     lcd.print("  SMART BOTTLE  ");
     lcd.setCursor(0, 1);
     lcd.print("    WELCOME.    ");
     delay(100);
    }
    String mystring ;
    mystring = String(i);
    Serial.println(mystring);
    Serial.println(" ");
    delay(2000);
}
```