IoT Based Intelligent Medicine Tray for ICUs in Multispecialty Hospitals

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***Abstract*—**Medical Sciences has invented many new technologies and are still doing researches in many ways. But integrating Medical Science with Engineering has made a boom in R&D field. These days Automation is going towards the peak point. Thus, when this automation comes into picture in Medical field, this makes the scenario perfect. All parameters of a patient are monitored on its own and so slowly it's becoming no man technology. Only we need to take care of is presence of incharge Doctor or nurse in case of emergency. We have here tried to implement this idea practically by some extent and well this can be brought to betterment in future by applying much advanced technologies.

Keywords*—Arduino; Intelligent Medicine Tray (Trolly); IoT; ICU; Heartbeat; Body Temperature; Emergency*

I. INTRODUCTION

Human tendency is to earn well so that he can secure his future and make his present better day by day. But we humans are so much involved in our life betterment that we ignore our health issues but if ignored this leads to major health issues. Heart related problems are growing tremendously. When we compare our population, the no. of beds in hospitals and the no. of Doctors' present altogether, obviously what we see is our population is too much high. People when run to hospitals in emergency, no vacant beds are seen to get admitted or have to wait for long to get the proper treatment. Here we are trying to say that these many problems can be reduced to some extent with the help of automation. Many researchers are already working on it; likewise we have put on some of our long term efforts to ease this situation.

Need of Intelligent Medicine Tray for ICUs

The main objective behind this need is to give a very time efficient treatment to patient in need in the ICU. It has been seen that in some hospitals, the ICUs are many times filled with the patient's relatives. But they worry if their patient is given proper treatment or not; if any nurse or Doctor is continuously looking after their relative or not. But being an Intensive Care Unit it should always be maintained clean, dust proof and sound proof. Thus if automation grows in these units of hospitals then number of nurses to be present in ICU always will be reduced and relatives won't have to keep worrying. By implementing IoT here, Doctors need not visit patient frequently and check patient's health status from his cabin. Even if the Doctor is out of station, he can check the patient's health status from his android mobile or laptop or PC just with the help of IoT concept.

II. LITERATURE REVIEW

According to the study on existing systems, we come to know that researches have done a great job in this field. Many systems have worked on a concept called medicine box that are stationery and tells us about the availability of medicines in the box. With some of our more efforts into the same field but on a track little different from this, we have tried our best to develop a medicine tray which will be intelligent enough to convey the emergency signal to hospital staff passing outside ICU. The system in [1] is the literature review for our system. Our main idea of an Intelligent Tray comes from [2] [11] Intelligent Medicine Box concept where Medicines that are finished or about to get finished will be known to concerned hospital staff well before time. We have used Arduino in our system as it is inexpensive, easily available but Raspberry would also have done as in [3] [8] with integration of IoT. [3] [4] [5] have all made use of IoT in different manner for Health Monitoring whereas [5] has used RFID along with IoT which was a good concept to know if we can emerge RFID into our work. [6] Gave us an idea to make use of Heart rate and Body Temperature as basic monitoring parameters and additionally we have made use of Saline Level Indicator for our work. Intelligent Medicine Box and IoT are integrated with Bio sensors in [7] but being on small scale we have not made use of Bio sensors as they are expensive. We have made use of Arduino by studying it thoroughly and referring [9] [10] [12] which were very appropriate for implementing our idea practically. [13] This system helped us in knowing that how can we make a system which will automatically remind the concerned person about an emergency via SMSs. [14] This is a basic survey showing integration of Bluetooth with health parameters. But Bluetooth being not able to cover larger area was the limitation for us and thus preferred Wi-Fi over it that comes many advantages.

III. SYSTEM METHODOLOGY AND DISCUSSION

The proposed system is a saga based on four main parts namely:

1) Intelligent Medicine Tray
2) Sensors for monitoring patient's Heart rate, Body temperature and Saline level continuously
3) Emergency panel outside ICU with buzzer and indication in case of emergency
4) IoT for remotely accessing Patient's Health status

Intelligent Medicine Tray: The movement of this tray will be based on IR sensors that will detect the black track on the floor and use precision motors for left or right turn. Patients in the ICU need to be given regular doses of medicines at certain interval of time. This time will be programmed using the compiler and the program for tray. This tray will move to the patient's bed if it is the time to give patient his medicine and will simultaneously display message on panel outside ICU that it is moving. The buzzer will beep for 10 seconds so that the Nurse outside the ICU will come to know about this. Thus, even if no staff is present inside ICU, the staff passing by outside the ICU will come to know this message. By the time tray reaches the patient's bed, the nurse will also come to the patient and treat him using required medicine. This tray will have a display over it showing the patient's name, Medicine to be given to the patient at that time along with the patient bed number. We have established the communication between the tray and emergency panel outside ICU using transreceiver pair of 2.4 GHz. Black track to be followed by tray will be laid on the floor.

Fig. 1. Intelligent Medicine Tray along the Black track to be followed

Sensors monitoring Patient's Heart rate, Body Temperature and Saline Level: These sensors play a very vital role here as they will keep monitoring the heart rate, body temperature and saline level for a patient. We have used these basic parameters at this stage. Thus these can be changed to BP rate, Sugar level and many more in further development. We have studied the min range and max range for each sensor and thus made some values as remarks in this system so that if any of the parameter goes beyond the range set in program, then this signal will be send as emergency signal on the display panel outside ICU with a buzzer which will stop only when the patient will be treated and the acknowledgement button near the patient bed will be pressed. If he is left unattended then the buzzer will keep beeping.

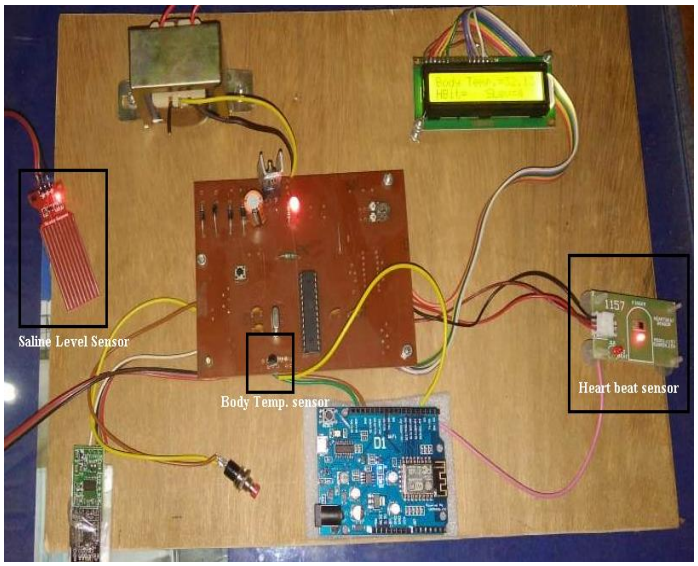

Fig. 2. Figure showing Saline level sensor, Body Temp. Sensor, Heart beat sensor (from left to right with Black Square around them)

Emergency Panel outside ICU: This panel outside ICU unit will be synchronized continuously with the Patient inside using the Transreceiver pair. Thus if any parameter of the patient goes outside predefined range then buzzer will make the sound. Additionally a display has been provided on this panel which will show the type of parameter emergency along with the patient name and bed number which will save time to find out for which patient the emergency is when Doctor or Nurse enters the ICU. Thus this system is said to be a very time efficient system. This emergency panel will also show the message on its display that the tray has started moving using the transreceiver pair between the emergency panel and the medicine tray.

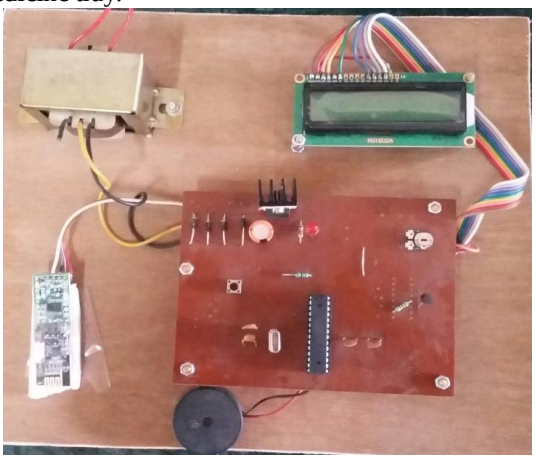

Fig. 3. Emergency Panel outside ICU with Display and Buzzer

Remote Access using IoT: Sometimes due to more number of patients under treatment or visiting patients, Doctor cannot always visit the patient in ICU. In such cases if any of the parameter of patient goes out of range and is left untreated then this situation may lead to catastrophe. So IoT is used here so that the Doctor when is not able to visit the ICU and check the patient on regular basis then he can simply keep his Desktop/ Laptop/ Android Mobile logged in and check the patient's health parameters. Here we have used www.thingspeak.com for IoT implementation. Using this, the parameters will be display on the system every 45s along with the updated values.

System Block Diagram

Currently this system is working for one patient with one medicine tray and further work is going on to make one medicine tray work for two patients. This system basically consists of four main blocks. These blocks are the Medicine Tray, the emergency panel outside ICU with display and buzzer, sensors panel with its information on the patient's respective display and the IoT part. IoT has made this work more efficient as we can access the patient health status remotely on a desktop or android mobile.

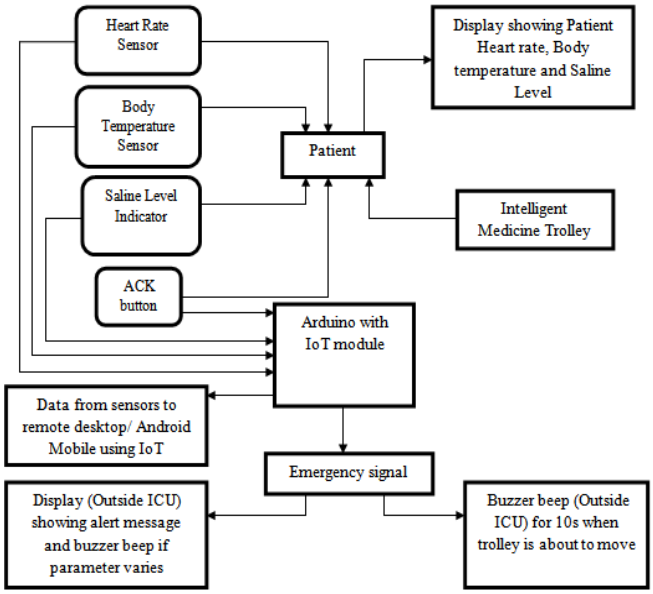

Fig 4. System block diagram

System Flow Chart

The implemented system will work according to the flow shown below.

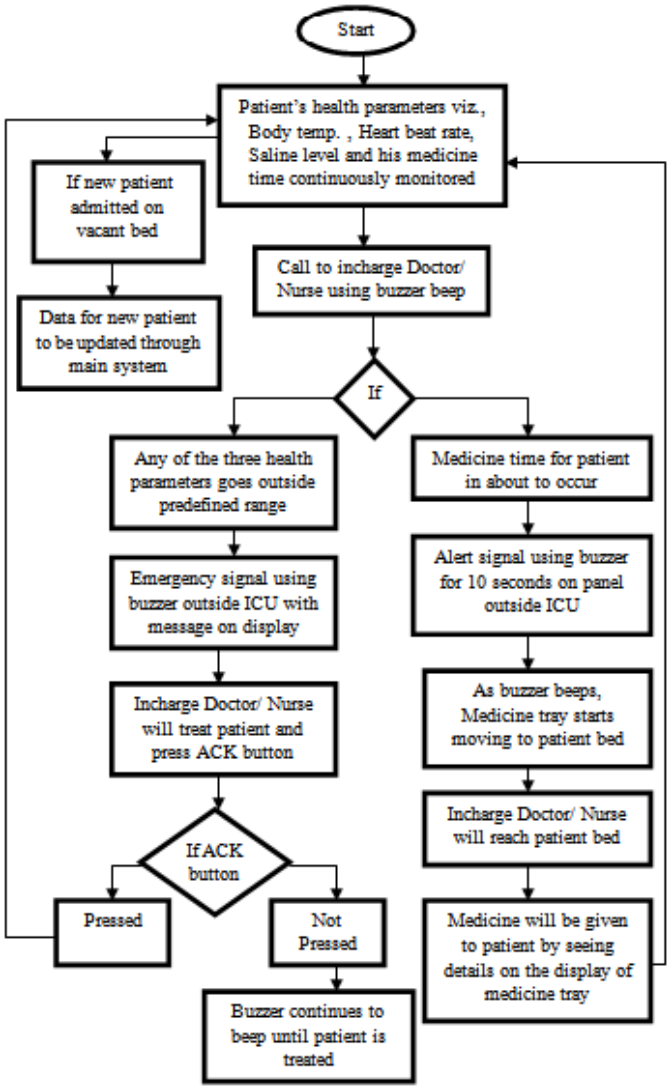

Fig 5. Figure showing system flow

Algorithmic Steps for System

The proposed system will work based on the algorithmic steps below:

1) Patient's health parameters viz., Heart Beat rate, Body Temperature, Saline level and his medicine time will be monitored continuously.
2) Emergency will occur and buzzer will start beeping if
   Case I: Any of the three mentioned health parameters of the patient has reached beyond the predefined range
   Case II: If it is the Medicine time for the patient
   Case I:
   i) Emergency panel outside the ICU will start beeping the buzzer continuously with the name of parameter emergency with the patient name and bed number on display panel.
   ii) The incharge Doctor/ Nurse if available outside ICU r any Staff member passing by outside ICU will see the message on hearing the beep and take immediate actions.

iii) Once the patient is treated the ACK (acknowledgement) button near the patient bed must be pressed for acknowledging that the patient is given the required treatment. If the ACK button is not pressed then the buzzer will continue to beep. Example: In case if its Saline emergency then the Doctor/ Nurse will come and change the saline but if he does not press the ACK button then buzzer will keep beeping even though the empty saline is replaced with the new one.

Case II:

i) If it is the medicine time for the patient then an alert signal will be given for 10 seconds using the buzzer on emergency panel outside ICU. Along with this, the medicine tray will start moving and stop at the patient's bed using the Black track on the floor.

ii) By the time tray reaches the patient, Nurse will reach the patient bed.

iii) For giving the patient his medicine at that particular time, nurse won't need to remember his health history or refer his file every time. This we have made easy by showing the Patient name with his medicine name at that time on the display attached to the Medicine Tray. Thus if the nurse is not available then even other staff member can give the patient his medicine on time.

Once done, again the controller will start monitoring the parameters.

IV. EXPERIMENTAL RESULTS

Initially when working on this idea, some goals were set to be achieved. After the implementation of this goals achieved, some practical results have been explained below. As shown in the fig. 4, initially when there would be no emergency, then "No Emergency" message will be shown on the display of emergency panel outside ICU. We will check the results one by one. Initially as in fig.6, Body temperature is 32.13 degree Celsius, Hbit means heart beat is 72 bpm and SLev means saline level is 151 units. When we consider the Saline emergency, then we have done this by dipping the saline level sensor in a glass of water up to the marked strips of sensor and then when we remove this then the saline level will start to reduce and soon will be zero and show us the saline emergency message outside ICU with buzzer beep. When the emergency will be treated then the ACK button must be pressed and thus this will show the message "ACK accepted" on display outside ICU as shown in fig.8.

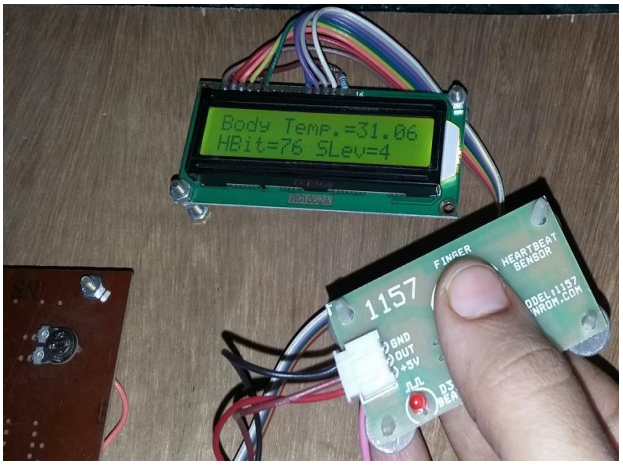

Fig. 6. Figure showing all three parameters that are monitored

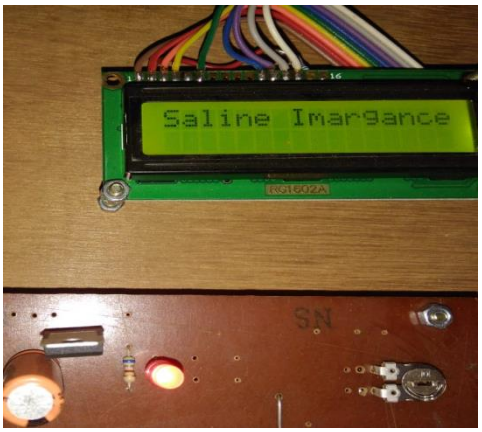

Fig 7. Figure showing Saline emergency on display outside ICU

Fig 8. Figure showing ACK accepted on display outside ICU

Further we have created temperature emergency here by placing a heated soldering gun near the temperature sensor for showing results.

Fig 9. Figure showing Body temp. Emergency on display outside ICU

When the tray is about to move to patient's bed, then it will display message on panel's display outside ICU that trolley has started moving and this will also beep the buzzer for 10s so that if no staff is present inside ICU then any staff passing outside ICU will hear this and come inside to give medicine to the patient.

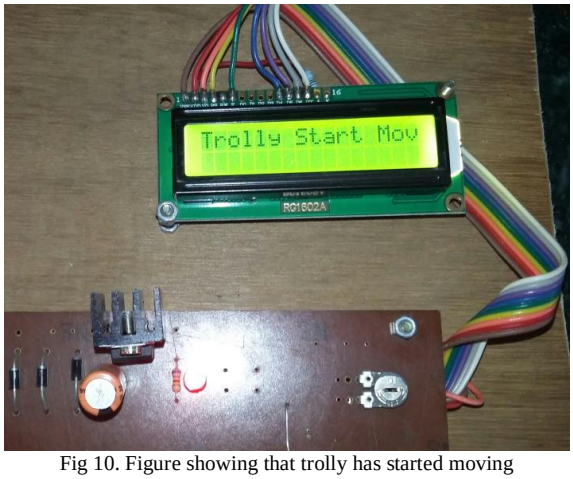

Fig 10. Figure showing that trolly has started moving

The heartbeat rate and body temperature of the patient which is continuously monitored will be updated on our channel of thingspeak every 45s which in shown in fig 11 and fig 12 respectively.

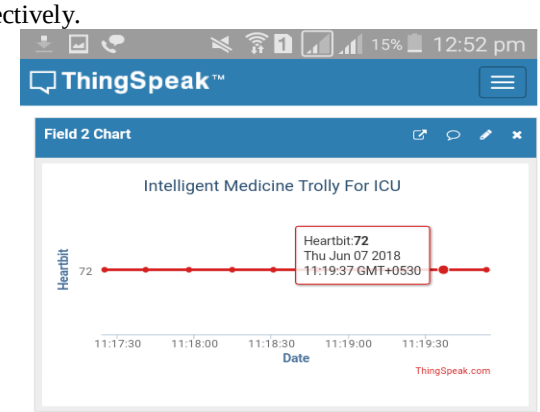

Fig. 11. Heartbeat rate updated on thingspeak

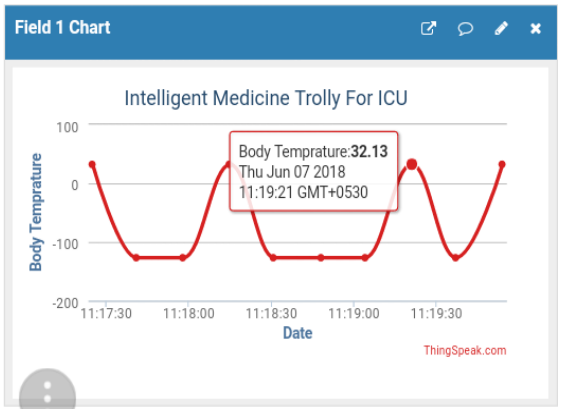

Fig.12. Body temperature updated on thingspeak

Now what comes next is the heart rate emergency which we can't show here because we need a real patient for this and that too whose heart rate is increasing and going outside range but this is working. After this when the medicine tray is about to move to patient bed when medicine times occurs then fig. 13 shows the details of the patient and medicine to be given with the room no. on display of the tray using which any staff available at that time near the patient can give patient his medicines.

Fig 13.Patient name (randomly taken for example) with medicine name on medicine tray display

V. CONCLUSION AND FUTURE SCOPE

In this work we have tried to build up a very time efficient system for giving treatment to patients inside ICU without time delay. This system can now work with ratio of 1:1 i.e. one medicine tray for one patient. The system will continuously monitor patient's health parameters like body temperature, heart beat rate and saline level. Also it will keep checking if the medicine time for the patient is about to occur and take required action as explained in algorithm and system flow. The Intelligent Medicine Tray shows the Patient name with his bed number and the name of medicine

to be given to the patient at that particular time. We have also established communication between the tray and emergency panel outside ICU for the acknowledgement of trolly has started moving. In future this system can be advanced by using RFID tag instead of IR sensors used here. Along with this, this system will be advanced by us to implement return path for the medicine tray from patient's bed to its original position so that when the medicine is given to the patient then the tray will return to its original position on its own.

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Priority Based City Traffic Regulation for Emergency Vehicle Using IOT

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Abstract- Due to rapid development of metropollutant cities no of vehicles on road increases hence in result traffic congestion is also increase rapidly. Trafficcongestion is major problem in big cities especially in rush hours.Emergency vehicle often stuck in traffic jam and it can be dangerous for any one's life. Hence aim of this paper is reduce waiting time of emergency vehicles and gives conditions information about traffic density on different road to emergency vehicle. For traffic density measurement IR sensor use as input data of traffic density send on internet using IOT. RFmodule gives information about presence of emergency vehicle. Problem of two EVs with same priority also solve in this project. Driver of emergency vehicle check traffic density at particular traffic signal from internet

Keywords- Emergency vehicle, traffic density, IOT**.**

I. INTRODUCTION

Increase in number of vehicles cause increase in traffic congestion hence most affected due to traffic congestion problem is emergency vehicle like fire brigade, ambulance. If any patient in ambulance suffering from dangerous situation want to gives urgent treatment but this emergency vehicle will get stuck in traffic then this very dangerous for one's life .Traffic light play very important role in for traffic management but it is static in nature time duration of traffic light is constant cannot change with respect to traffic density hence dynamic traffic light control play very important role for traffic management. there is no doubt emergency vehicle will not wait for green signal but in such case if any accident happened it alsocouseheadache. Hence our aim is to make automatic lane clearance for emergency vehicle.

Existing system:

1) Simple traffic management system-Here one traffic police officer allocated at every intersection and it controlled traffic by hands. He gives instruction of stop or wait to driver but it is very inefficient method many times driver violence rules.
2) Automatic traffic management system -there three different color light use for traffic management green light is 120 second on and yellow light is 20 second to indicate ready to go and all other time red light on to asking for stop. but here duration of light is fix and it cannot distich between emergency vehicle and ordinary vehicle
3) Traffic management using wireless sensor- network here wireless sensor used for collect data regarding traffic density size of vehicle length of vehicle speed of vehicle inWNS consist of small tiny components which sense surrounding it can collect process and transmit data it operate in real time it interchange information to other nodes or base station.
4) Intelligent traffic management using image processing- Here camera is mounted on high pole to measure traffic density. Camera mounted on high pole can cover larger distance hence picture capture by camera process by computer to analyze no of object different object like truck ambulance etc. it is also useful to detect violation of traffic rules by driver. But camera should be robust it need to place at each phase.

II. LITERATURE REVIEW

Wireless sensor network- is newapproach to control traffic flow sequence it compose of small tiny device to collect manipulated and transmit data between two nodes and base station it place at road side . It dynamically adaptive technique for single or multiple intersection. nodes are communicated wireless and also self organize it use for reducing waiting time of emergency vehicle[1],[2],[3].Image processing- in images processing system image sequence capture by camera analyze and use different edge detection techniques and object counting techniques. to get no of vehicle and to get information about different vehicles (cars Truck Ambulance) in case of emergency ambulance gives priority over others[4],[5],[6]. Reference paper [7],[8] provide approach to provide priority for emergency vehicle and traffic management for emergency vehicle here RFID use for calculate traffic density and detect the emergency vehicle. Communication between traffic signal and emergency vehicle is done by transceiver and GPS, at starting driver of ambulance enter destination andhence whole system inform all traffic signal in way of emergency vehicle .when emergency vehicle is away from sufficient distance form traffic signal then all red signal turn into green and actual distance of EV is monitor through GPS, but here starting point and destination point of EV is necessary. If EV change rout due to some reason it will collaps. Paper[9] green light period of traffic signal pays important role in traffic management. Paper present technique to control green light period of traffic signal as per requirementaccording to traffic density and on base of time require for EV to cross traffic junction. paper approach technique to estimate travel time require for cross junction. [10]provide solution using zigbee wireless communication protocol and GPS receiver. Here IR speed sensor use to find

speed of vehicle and according to speed of vehicle it set color of traffic signal EV

Need of Dynamic Traffic Management System:
My aim is to implement dynamic traffic management project implementsdynamic Traffic Signal other than Static. The reason for this decision is to adaptthe signal control to dynamic traffic flow. The number of vehicles arrived at the traffic signal intersection varies from time totime hence static traffic control may prove to be unreliable. Moreover it has also been observed thatPeriodic Signal Control is unable to perform up to its potential in case of very busy intersections.

III. PROPOSE SYSTEM

Propose system consist of two main part
1) Emergency vehicle unit
2) Junction unit

Emergency vehicle unit- this unit is to be installed in emergency vehicle it consist of RF transmitter and key to assign priority as per situation and QR code to check traffic density at different traffic signal in case of fire brigade and as per condition of patient in case of ambulance.

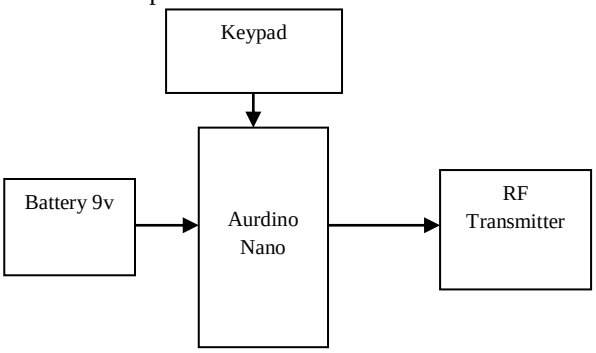


Fig.1: Block diagram for emergency vehicle

Traffic density collected by IR sensor can be monitor by EV driver on internet in android mobile by using QR code. Three keys are used here to press button for indication of level of priorityand four keys to indicate on which direction or signal EV want to go.Assume ambulance consist of three person driver Nurse and patient and relatives of patient is optional first of all authorize person of hospital check the heath status of patient and press key as per heath condition.
E.g. Heart attack, pick up patient from disaster sites-------- Higher priority.
Small accident --------- medium priority
Shifting of patient --------- lower priority etc.

In case of Fire brigade:
Any mall or industries, hotel full with humans suffered from fire ------- higher priority
Cemeterysuffered from fire containing ------- medium priority
Any small commercial shop without human suffer from fire gives -------- medium priority
Saw mills, any old means (lower priority)
According to reported information driver of fire brigade, Ambulace press that particular key.

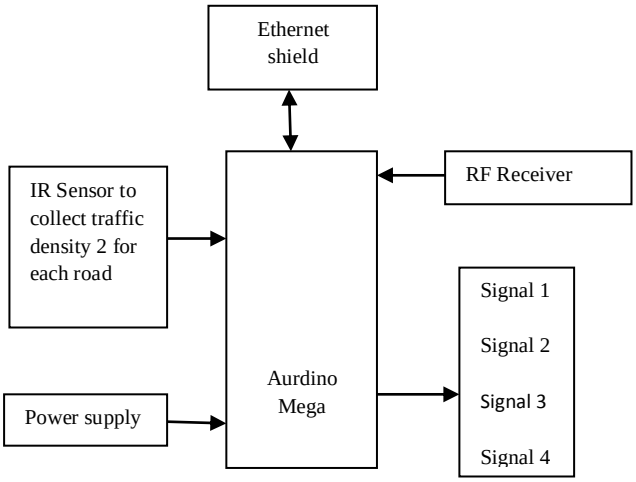


Fig2: Block diagram for Traffic Signal

Junction unit - IR sensor used for check traffic density on road near a junction and send it on internet using IOT to available for EVs driver to check traffic density this traffic density can driver seen it on internet. RF receiver received signal send by RF transmitter and make signal for particular timeIn additionto regular three colors red green and yellow one additional blue signal use for traffic signal to indicated that when EV is coming then blue and green signal will turn on .

How It Will Work
1) For providing dynamic traffic control first calculate capacity of that particular road in propose system we assume that capacity of particular road is 100 it consider on two wheeler.
2) IR sensor continuously monitors traffic density and according to traffic density traffic signal time will change. It will indicate traffic density in percentage. According to traffic signal it will determine the time of green signal.
3) EV detection- Here for demonstration purpose we have use RFtransmitter and receiver when ambulance come in rage then it broad cast signal to station and it will automatically set green signal on path of emergencyup toEV cross junction and also turn on blue signal to notice other driver to stop or slow down gives priority for emergency vehicle.
4) When two EVs reach near junction check priority of vehicle giving higher priority gives first.

IV. STEPS OF PROPOSED TRAFFIC SIGNAL ALGORITHM

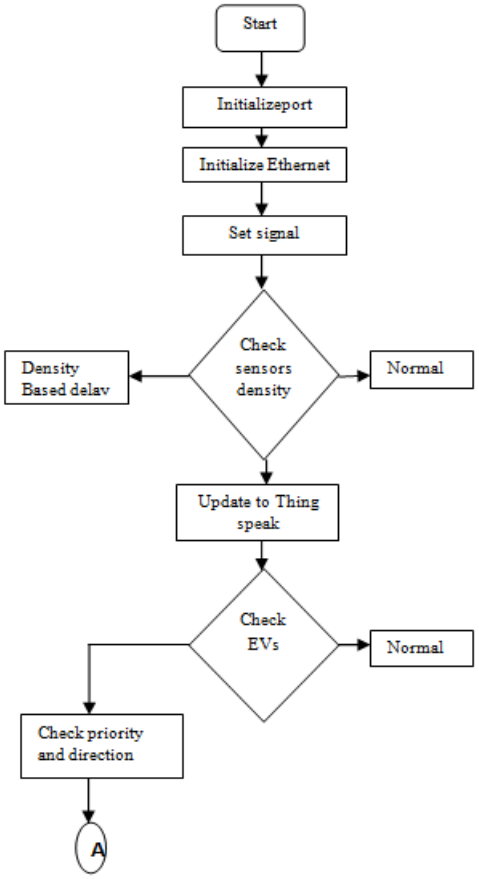
The proposed algorithm contains seven steps:
1) Determining the queue length (volume) of traffic.
2) All the vehicles run at a constant speed and all the vehicles are in the same type.
3) All traffic density data send to internet usinginternet of things(IOT) on thingspeak.

4) According to traffic it will change traffic signal green signal time
5) Traffic density cross predetermine level of traffic then signal turn green.
6) Every vehicle driver can detect the traffic density at particular road on internet using QR code which is given to every emergency vehicle .Every ambulance must have a chart depicting the condition code along with its description. For example
7) After making the necessary checkup the nurse enters the relevant condition code

Check of Emergency Vehicle Presence:

1) If any emergency vehicle is detected system turn signal to green up to emergency vehicle crosses the particular range.
2) If tow emergency vehicle present at same lane then up to second emergency vehicle cross that particular signal is remains in on condition.
3) When two emergency vehicles occurred from different lane then system will check priority first according higher to priority that particular vehicle gives first priority and then make signal green on second emergency vehicle.
4) If two emergency vehicle presented same time with same priority(higher) then system will gives priority to EV which send request first and then shift with second one

V. SYSTEM FLOW CHART



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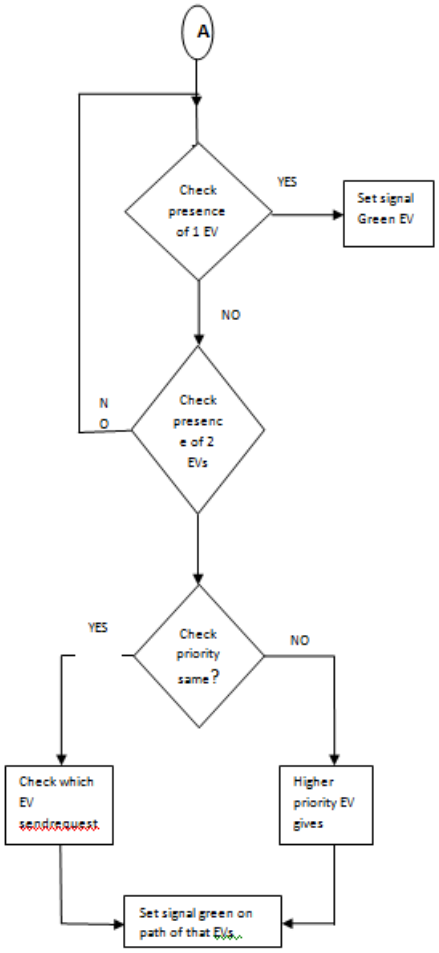

VI. EXPERIMENTAL RESULTS

Aim of this project is fulfilled traffic light signal is time is change according to traffic density. Traffic density data collected by IR sensor is send to internet via thingspeak IOT platform. Driver of Emergency vehicle can check traffic density onthingspeak in case of emergency to select with low traffic path. When any emergency vehicle is inform traffic signal for crossing particular junction then make that signal green for predetermine time. but if at same time two EVs come with different priority suppose one with high and another EV from another path with low priority then it gives priority to high priority vehicle then switch to low priority and then turn to regular cycle. In Case 2 when two emergency vehicles with same priority arrived at same at same time but if there is small time lag between two request. This time delay can be analyze by controller on the basis this first come and first out which vehicle send request first then gives priority to that particular vehicle.

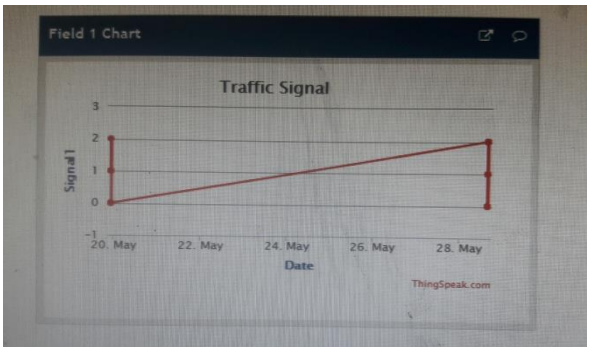

Fig.4: traffic density at signal 1 on thingspeak

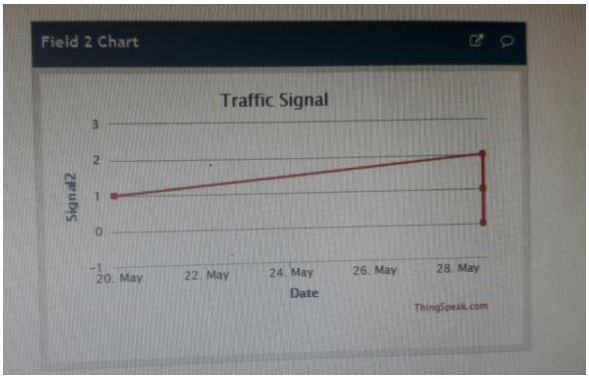

Fig.5: traffic density at signal 2 on thingspeak

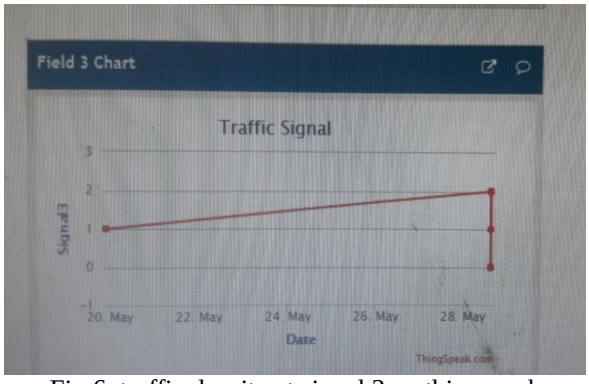

Fig.6: traffic density at signal 3 on thingspeak

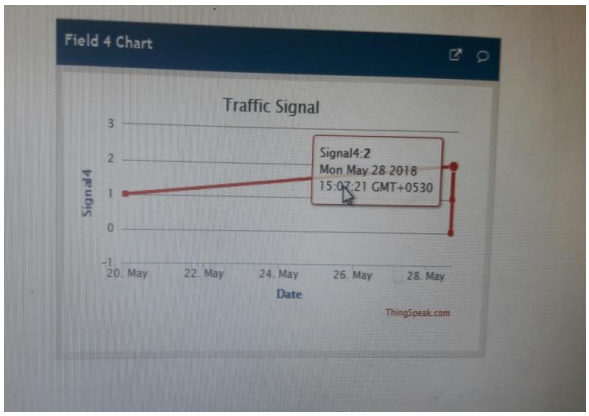

Fig.7:traffic density at signal 4 with time and day information of data updated on thing speak

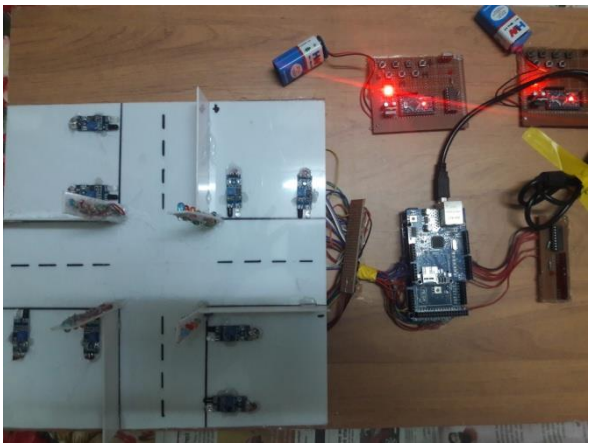
Fig.8: Experimental setup

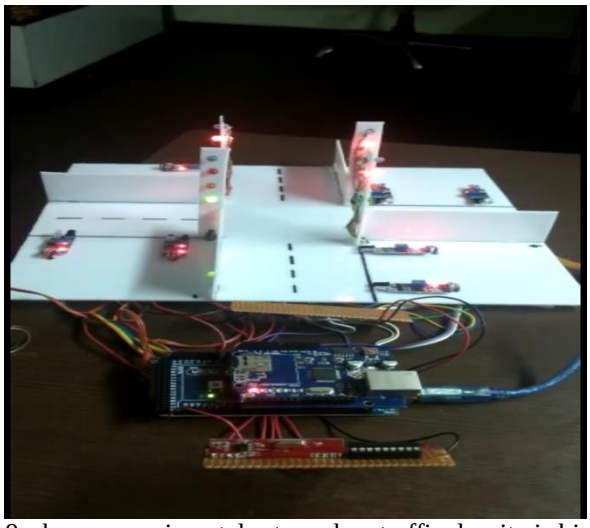
Fig.9: shows experimental setup when traffic density is higher set green signal

Image 1,2,3,4 show output of data send on thingspeak using IOT it shows traffic density at different traffic signal with updated time and day information.

VII. CONCLUSION AND FUTURE SCOPE

In this project successfully completed target to reach emergency vehicle at destination in short time by providing information of traffic density at different junction on internet by using IOT. And also solve problem when two emergency vehicle come at same time with same priority then on the basis of first come first out EV send request first will gives priority.In future for security purpose we can add some password system and here only persons having.

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INDUSTRIAL PARAMETER MONITORING AND FAULT DETECTION FOR SAFETY USING IOT

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***Abstract*—** Automation has changed the way we live. There were tasks that used to take a lot of our time and efforts that are now being done by machines. But it can proven to be cursed some time when it crosses their operating limits, hence monitoring and controlling is called as a heart of industrial parameter. Industrial parameter monitoring is the process of real time monitoring of parameters and its control using programming. This project presents the implementation of real time embedded system for industrial automation applications. Recently, PLCs have dominated industrial automation implementations but however, they do present some challenges especially in meeting real time constraints due to its centralized control and cyclically scanned program execution mechanisms. This project proposes a practical way to precisly monitor physical parameter like voltage, current, temperature, humidity and light intensity for the safety of industrial processes and its monitoing using IoT.

***Keywords*—** *Industrial Automation, Internet of Things, ARM7, Sensor, Parameter Monitoring.*

I. INTRODUCTION

The end of the 20th century has brought important new trends in all industries particularly in terms of engineering. The main consequences to apparel manufacturing have been a constant increase of individual production orders, product and materials variety and much smaller order quantities. This fact posed new requirements on the production systems and equipment: both have to be flexible and reliable. In the case of the equipment, this means that quicker set-up times are required whenever process changes and that quality assurance has to be much more efficient. Managing this situation with the traditional machine set-up and process planning methods is difficult. Better control and predictability of the processes are required.

Automation is essential and well proposed system in 21st century. The industrial world is facing many technological changes which increased the urgent demand for the premium quality products and services that can only be supplied by a high level of productivity. This requirement needs process engineering systems, automated manufacturing, and industrial automation. Hence, industrial automation plays a key role in solving the requirements of companies. On the other hand, many people losing their lives in industrial accidents due to presence of black holes while implementation of automation in industries. When we talk about industrial automation is all about working smarter, faster, and proficiently we need to monitor some critical parameters like temperature, voltage, current, humidity, pressure etc. This is one of the most upcoming issues in the industrial sectors. If the parameters are not monitored and controlled properly due to unavoidable manual error, it leads to a harmful situation. Sometimes, if this control process may not handle properly, it results in occurrence of major accidents. With the embedded technology, it is very easy to overcome the greater issues in industrial automation monitoring and controlling. Embedded System is the combination of both Hardware and Software. Embedded system allows the flexibility to user to design the automation system with greater power efficiency. The operations performing in industries are very fast and they are not possible to monitor for normal human eye. Hence, various types of sensors can be used for monitoring purpose which is available in market. Embedded system allows interfacing these sensors using computer program for greater efficiency and fault detection capability, which also ensure the safety of industry premises. Embedded system also allows interfacing of internet with hardware using IoT and IoT provide the flexibility to monitor and detect faults present in system from remote location using "User Name" and "Password".

II. RELATED WORK

The concept of industrial automation was first introduced by Jacques de Vaucanson and he was invented first automated loom. [4] Author does the survey on implementation of real time system for industrial automation. In this paper author explain how the PLCs are dominated industrial automation implementation but the use of PLC system requires more cost for implementation. [3] Author does the survey on recent trends and application of an embedded system. In this paper author explained what embedded system is and how it can be applicable for industrial solutions. About all the microprocessor and microcontrollers are manufactured using automated process and as it can be easily programmed with high level language, they are very popular in industry. [2] Author does the survey on Internet of Things from market perspective. In this paper author states that Internet of Things is dynamic global information consisting of internet connected objects that are becoming the integral component of Internet. This survey is intended to serve as a guideline and conceptual framework for context-aware product development and research in IoT paradigm. [19] Author does the survey on data acquisition system. This paper is about how the data acquisition system

has been used in various applications in the world. Data acquisition is a collection of data. The data might be collected from local objects or from remote location using sensors for the monitoring on which processing can be done further. [6] Author introduced the emerging trends of embedded system for industrial automation. In this paper author states that, embedded system is a combination of computer technology and electronic hardware which is designed for strict application system on function, reliability, cost, volume and power. Author had provided a detailed view of embedded processor for industrial use. [17] The importance of Real Time Industrial Monitoring System is given by author and also proposed how we can monitor process using RFID in this paper. [9] The importance of ARM microcontroller and its scope in industry is given by author in this paper. The rapid development of the field of industrial process control and the fast popularization of embedded ARM processor; it has been a trend that ARM processor can substitute the single-chip to realize data acquisition and control.

III. HARDWARE DESCRIPTION

The implementation of system shown in fig. 1 consists of LPC 2148 ARM7, Wi-Fi Module, Power Supply and Sensors.

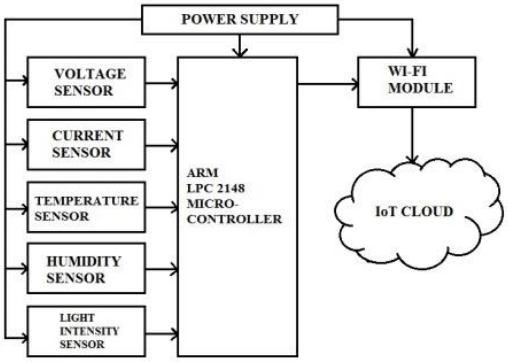

Figure 1 Block Diagram of Industrial Parameter Monitoring

A. LPC2148 ARM7 Microcontroller: The LPC2148 microcontrollers are based on a 32 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory of 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate.

B. ESP8266 Wi-Fi Module: The ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with Full TCP/IP capability. It has a Microcontroller Unit (MCU) integrated which gives the possibility to control I/O digital pins via simple and pseudo-code like programming language. ESP8266 Wi-Fi Module comes with PCB trace antenna which has very good coverage.

C. LM35 Temperature Sensor: The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature.

D. DHT11 Humidity Sensor: The DHT11 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed).

E. LDR: It is a light dependent resistor, works on photo conductivity principal. Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorbed by the material. Here it is use in this project for detection of light intensity.

F. Potentiometer: A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor. Potentiometer is used to demonstrate the change in voltage and current in this project.

IV. WORKING ALGORITHM

The system will perform operation in following steps:

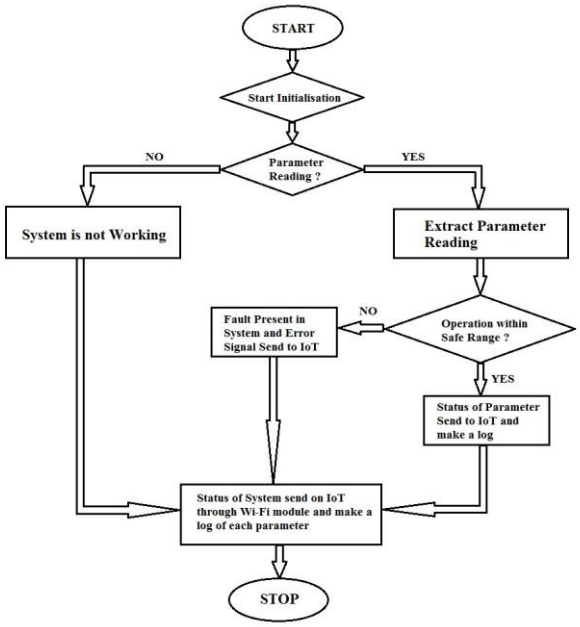

Figure 2 Flowchart of Industrial Parameter Monitoring

1. Turn ON the Power Supply to turn the hardware ON.
2. The initialisation program will starts executing, once hardware gets turn ON.
3. Sensor will start monitoring after initialising the program, and supply their output to LPC 2148 ARM microcontroller.
4. LPC 2148 ARM microcontroller will process the received data and it will be updated in LOG Page created on internet for online monitoring.
5. The program will continuously monitor the status of parameter under monitoring. System will generate the alert if malfunctioning is detected in it and turn OFF the system in case of any malfunction present in it.

This system also provides us the facility to monitor its status using internet from any remote location.

V. EXPERIMENTAL RESULTS

Figures show the results of industrial parameter monitoring using sensors. Images are showing algorithm of the project. Fig. 3 is an experimental setup without power connections.

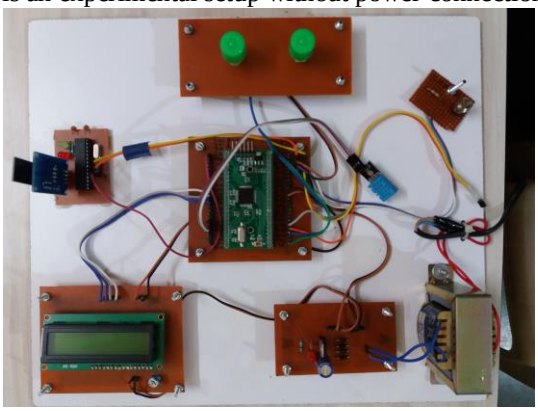

Figure 3

Fig. 4 is an experimental setup with power connections.

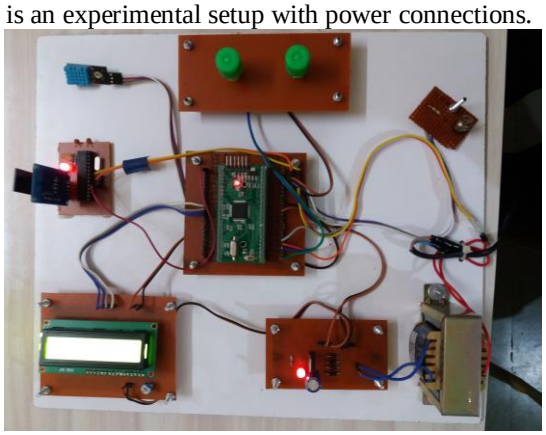

Figure 4

Fig. 5 is showing the initializing process.

Figure 5

Fig. 6 is showing the result of system after initialization, monitoring parameter and collecting their values.

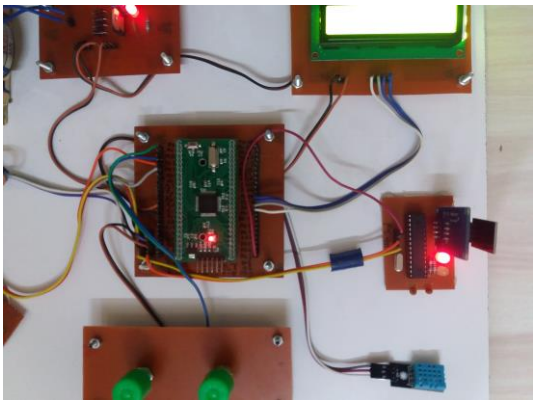

Figure 6

Fig. 7 is showing the result after the data is collected, updated in system and uploading on Website.

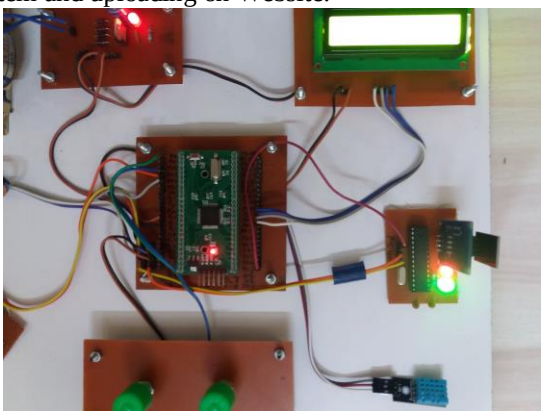

Figure 7

Fig. 8 is showing the result of parameter monitoring on LCD which will be continuously updated in every 2 seconds.

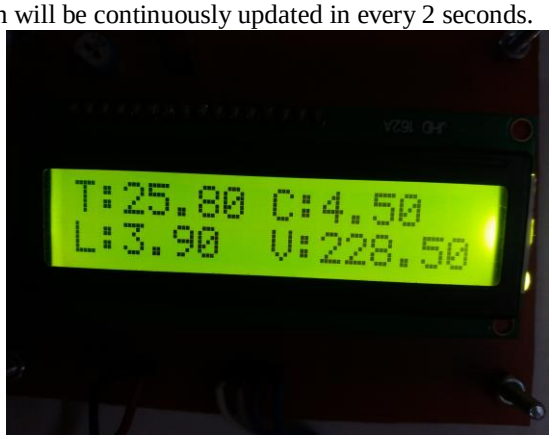

Figure 8

Fig. 9 is showing the result of parameter monitoring updated on website, which can be monitor online using user id and password.

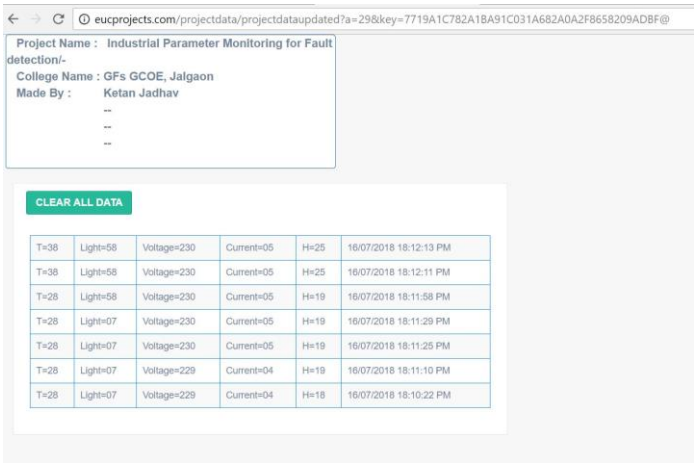

Figure 9 Online Log

VI. CONCLUSION

We have implemented system for Industrial Parameter Monitoring and Fault Detection for safety using IoT. The algorithm design is successfully monitoring the physical industrial parameters. We have also test our algorithm for faults and found that it successfully generating alert in response of faults. We have also monitor a log sheet of our system on internet using user id and password. Hence we can conclude that our system can provide safety to industrial processes.

Acknowledgment

I wish to express my pleasure of acknowledging and thanks towards ***Mr. Hemant T. Ingale and Mr. Vijay D. Chaudhari sir*** for providing the technical guidelines and constructive suggestions regarding the line of this work. He encourages me all the times for doing this quality research work in tuned with the target puts before me.

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In addition, I would also like to thank ***Dr. V. G. Arajpure, Principal and Prof. P. V. Phalak, Vice-Principal*** of GF's Godavari College of Engineering for providing me necessary resources and support granted throughout my master's fellowship.

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Multilevel Water Level Control & Monitoring of Multiple Tanks

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ABSTRACT

The traditional method of water tank overflow indication is to insert one pipe in the tank and whenever the tank is completely filled the water starts flowing through this overflow pipe this indicates that water tank is completely filled and the pump should be turned off. But this shows only tank filling status and does not indicate different heights or levels of water in the tank.
In this project water level of 4 tanks is monitored and controlled by controlling the motor which pump the water from reservoir to tank. For sensing water level float is used as sensing element. One float switch will sense one water level therefore for sensing 4 different water levels 16 float switches are used. Microcontroller 8051 is used for expansion of tanks. Therefore water level of many tanks is monitored and controlled. All these information is provided to ESP8266 Wi-fi module which is prefabricated arduino board.ESP8266 is used for controlling motor driver circuit and uploading data to server by inbuilt Wi-Fi unit. This project can be used in multi-storied buildings where tanks are situated at high places knowing the tank filling status is difficult. The user can control the water level manually if given access through admin by turning on/off motors which pump the water from reservoir to the tank. Otherwise guest user can only monitor the status of tanks which are made visible by admin for guest user.
By doing all these practices the traditional work of water level controlling becomes much easier, people sitting at remote place form the tanks system can easily do the job of water level controlling and monitoring for in house as well as industrial applications.
Key Words: *Webpage, ESP8266 Wi-Fi module, 89S52 Microcontroller, Float.*

1. INTRODUCTION

The traditional method of water tank overflow indication is to insert one pipe in the tank and whenever the tank is completely filled the water starts flowing through this overflow pipe this indicates that water tank is completely filled and the pump should be turned off. But this shows only tank filling status and does not indicate different heights or levels of water in the tank.

Water level monitoring and controlling plays an important role at remote places like mutistoried buildings, overhead tanks and tanks where there are number of tanks water level is to be monitored and controlled. This also reduces human manpower required for manually turning ON the motor in case of empty tank and turning OFF the motor in case of water overflow from the tank. It replaces the traditional method of using tank ball and power saving also done because we will keep the motor on whenever required.
In this paper 4 different levels of water of 4 different tanks are continuously monitored by user accessing the server web page, floats are continuously sensing the water levels, this level information is uploaded to server on regular basis by ESP8266 W-Fi module.89S52 microcontroller is used to for controlling Water level sensors and motor driver circuits.

2. LITERATURE SURVEY

This section discusses the survey of the different past research in the area of water level control of multiple tanks through remote place. Various method and approaches proposed by different authors are also involved. Based on this problem is defined and proposed system is discussed in successive section.

This section discusses the survey of the different past research in the area of water level control of multiple tanks through remote place. Various method and approaches proposed by different authors are also involved. Based on this problem is defined and proposed system is discussed in successive section.

Narong Aphiratsakun et al., presents to control the level of water in the tank using mobile application. For this purpose PID controller is used. The sensed water level information by sensor is applied to amplifier circuit which converts this into strong signals so that it can be manipulated. The motor is controlled by PLC and water is pumped into the tank according to the set point entered from mobile application [1].

M. Bala Krishna et, al., shows the control of water level in tank through controlling motor on and off system and employing mobile middleware application. The level of water is sensed by this application through sensors and water pump is stopped whenever tank gets filled message information is sent to registered mobile user about tank status this saves energy and cost [2].

There are many techniques used for liquid level measurement among which capacitance probe is very useful. Hiranmoy Mandal et.al., explains how the level of liquid is measured using metallic electrodes immersed in metallic tank. Coaxial cable is preferred because of having both inductance and capacitance effect. The results obtained are linear.

A. Atojoko et al.,explains how the liquid level is monitored and controlled in industries where liquid flooding is major issued. Passive RFID tags are employed for this task and signal variations from Alien Reader software find the level of liquid [4]. The circuit attached then switches the motor ON/OFF and tank flooding or overflow avoided which created the water pollution in industries due to chemical tank overflow.

In paper Sojoudizaeh, Sadeq et. al., CMOS chip based on fuzzy logic controls the level of liquid in tank. Valves control the water flow which is controlled by motor. 0.35 um CMOS technology is used to design controlled using CMOS chip. Chip is 0.42mm in size and consumes less power [5].

3. PROPOSED SYSTEM ARCHITECTURE

3.1 Proposed system

In this project water level of 4 tanks are monitored and controlled by controlling motors which pump the water in the tank from reservoir. For sensing water level in the tank float is used as sensing element. Each float switches sense the predefined level of water.e.g.25%.Therefore for monitoring multiple level of water we require many float switches. In this project 4 different levels of water is monitored hence 4 float switches required. For monitoring of 4 different water levels of 3 tanks 4*4=16 float switches required. There are two modes of operation.

1) Auto Mode: In this mode motor is ON continuously till the 4 tanks are filled completely/Overflow. Then motors are turned off automatically.

2) Manual Mode: In this mode we can change the valve ON position by sensing multiple water levels and controlling motors manually which pump the water in the tank. Also we can add new tank and remove existing tank.

All these information is provided to ESP8266 Wi-Fi module which is prefabricated on aurduino board. ESP8266 is used for controlling motor driver circuits and uploading data to server by in built Wi-Fi unit. It is programmed in AT commands. For tank controlling 89S52 microcontroller is used which is programmed in embedded C.

All these information is uploaded to server and stored in database which is updated at predefined intervals. The proposed system is implemented as shown in block diagram. It contains ESP8266 microcontroller which is having in built Wi-Fi module so as to upload data to web server. It uses the 89S52 microcontroller for controlling no of tanks and float switches. Float level switches and Solenoid valves are also used. The server web page is having unique domain and display the water level of each tank. It is also having following buttons. After pressing Auto Mode button system switches to auto mode, all other buttons will disappear from web page. On pressing Manual Mode button all remaining buttons should be displayed on web page and system switches to manual mode. Motor ON button is used to Turn ON motor manually. Motor OFF button turns OFF motor manually. On pressing Add New Tank button message should be displayed “Please enter tank number/name”. We will enter tank number/name then new tank will be added. On pressing Remove Tank button message should display all existing tanks. We select the tank which is to be removed and tank will be removed. Refresh button is used for updating tank status to server manually.

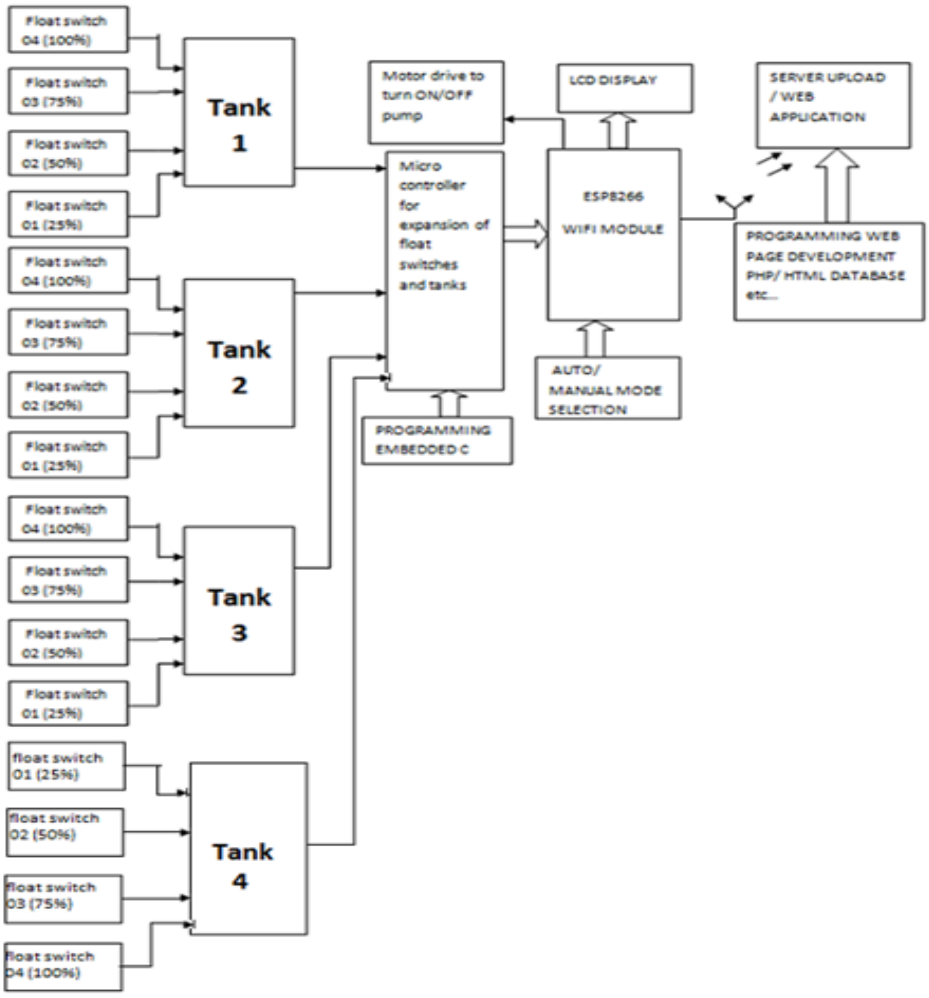

Figure1: Block diagram of proposed system

3.2 System Implementation

3.2.1 Software Tools used

The system requires 5v supply and only solenoid valve requires 12v supply for its operation. The software tools used for the proposed system are shown in below table.

Table 1: Software tools used

Sr.no	Software	Version	Description
1	Aurduino	1.6.9	Programming & compiling
2	Orcad	9.0	Circuit designing
3	PHP	5.0	Web page designing
4	HTML	Current	Database management

3.2.2 Hardware Implementation

3.2.2.1 ESP8266 Wi-Fi Modem

ESP8266EX itself has complete solutions of networking. It is used to host the application or to get Wi-Fi networking functionality from another application processor. ESP8266EX can be directly booted up from an external flash to host the application, it has in built cache to improve the performance of the system in such applications. Alternate to this, it serves as a Wi-Fi adapter and wireless internet access is added to any micro controller with simple connections. (SPI/SDIO or I2C/UART interface).

3.2.2.2 89S52 Microcontroller

In this project 89S52 microcontroller is used which is one of the version of 8051 microcontroller to control 3 number of water tanks connected. In this project 89S52 is used to connect and control 4 float switches, motor driver circuits, LCD display, relays and solenoid valves. We have used 89S52 which is a product of Atmel.

4. SYSTEM FLOWCHART

This section describes the flow of water level control and monitoring of multiple tanks project.

4.1 System Flowchart

The flowchart of system is as shown in fig

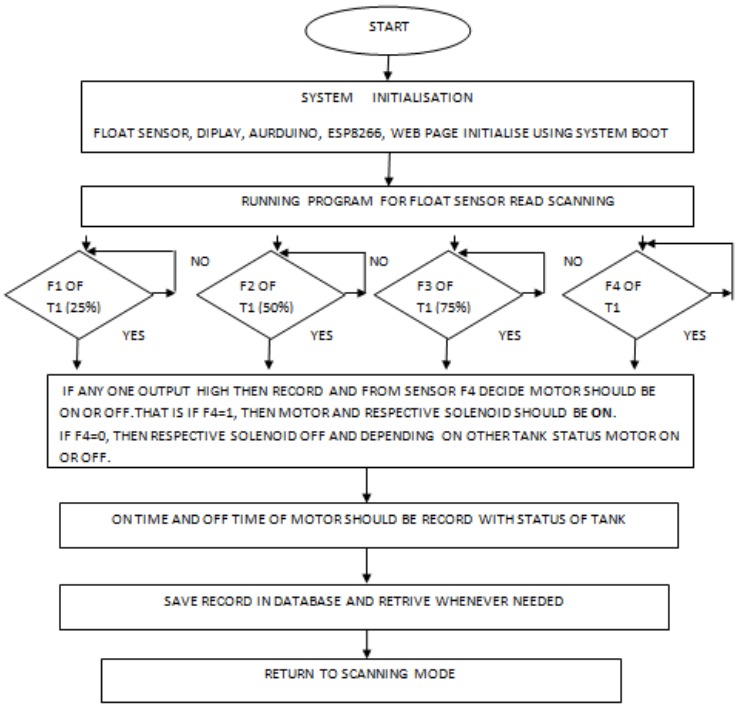

Figure2: Flow chart of system

4.2. Algorithmic Steps

1. Start
2. System Initialization
3. Float Sensors, LCD Display, ESP8266, 89S52, Pump motor initialize.
4. Run programme for float sensor read scanning.
5. If F1=25%, Off F1
6. Else
7. F1 is ON
8. Record data and update at server database
9. If F2=50%, Off F2
10. Else
11. F2 is ON
12. Record data and update at server database
13. If F3=75%, Off F3
14. Else
15. F3 is ON
16. Record data and update at server database
17. If F4=100%, Off F4
18. Turn off motor and solenoid valve.

19. Else
20. F4 is ON
21. Record data and update at server database
22. Record on time and off time of motor with tank status.
23. Save recorded data in server database.
24. Return to scan mode.
25. Stop

5. EXPERIMENTAL RESULTS

5.1 Hardware initialization:

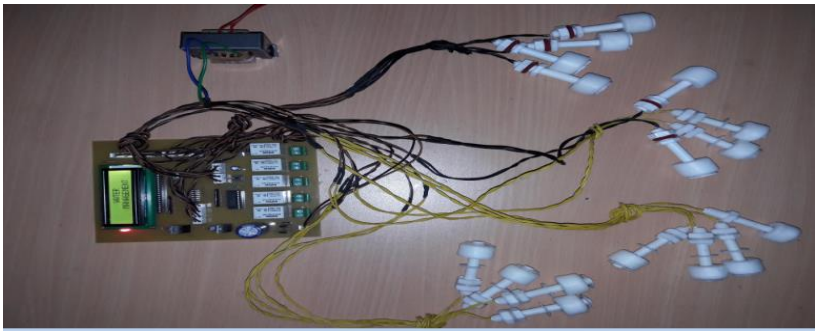

Figure 3: Hardware of system

5.2 Login to Website:

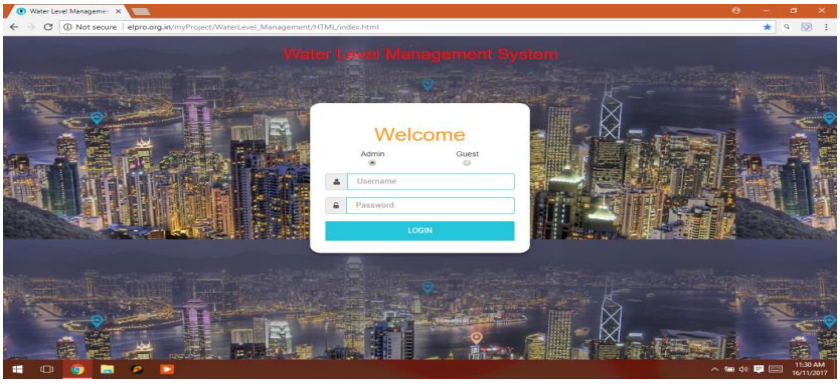

Figure 4: Login to webpage

5.3 Administartor login:

Enter the administrator login id and password, open Admin page select Automatic or Manual mode

1. **Automatic Mode:**

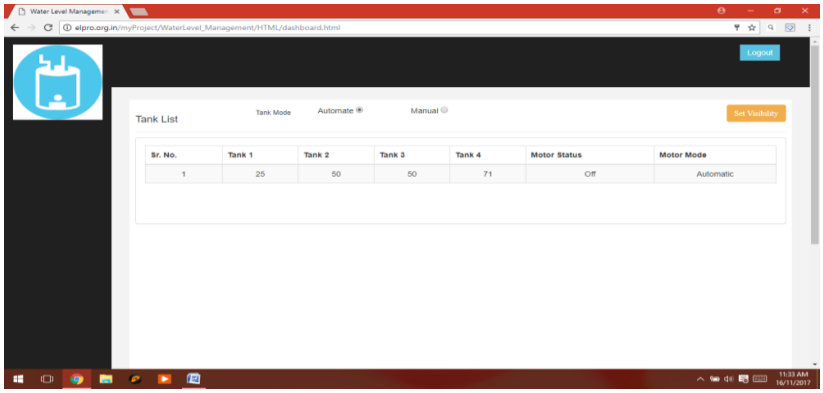

Figure 5: Automatic mode

2. Manual Mode

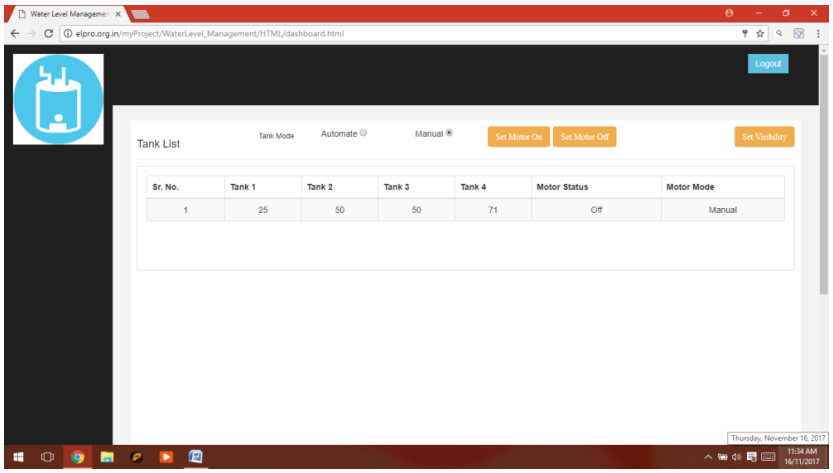

Figure 6: Manual Mode

a) Set motor On
b) Set motor Off
c) Se visibility of tank status for guest user

Guest Login: Enter the guset login id and password.

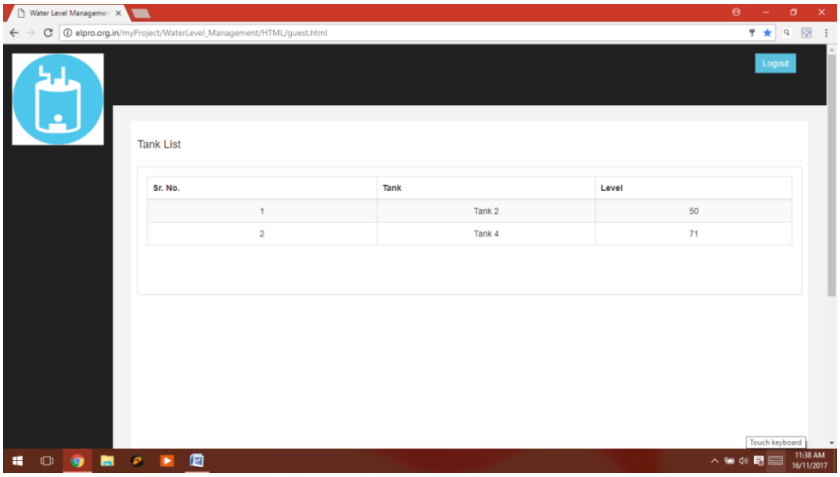

Figure 7: Guest login

5. CONCLUSION

"Multilevel Water Level Control and Monitoring of Multiple Tanks"system is successfully implemented. Thus by implementing this project the issue of monitoring and controlling of multiple tanks which are situated on terrace of multi-storied building is resolved. The manpower is reduced because only single person sitting at server room can monitor and control all the tanks. Electricity consumption is less because motor associated with each tank will be ON only when required. It has many advantages such as strong expandability, low operating cost and effective.

This system is becoming increasingly important in large cities and factories. It has real time capability. It is possible to implement the given system commercially. Upgrading the given system is very easy, this makes it more efficient.

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Hostel Rooms Power Management and Monitoring Using Internet of Things

Authors | Authors and affiliations

Meenakshi Patil, Vijay D. Chaudhari, Hemraj V. Dhande, H. T. Ingale

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Abstract

Power saving is the important issue nowadays, and it is more critical in hostels because of some irresponsible students who leave the room without switching OFF the tubes lights and fans. So,

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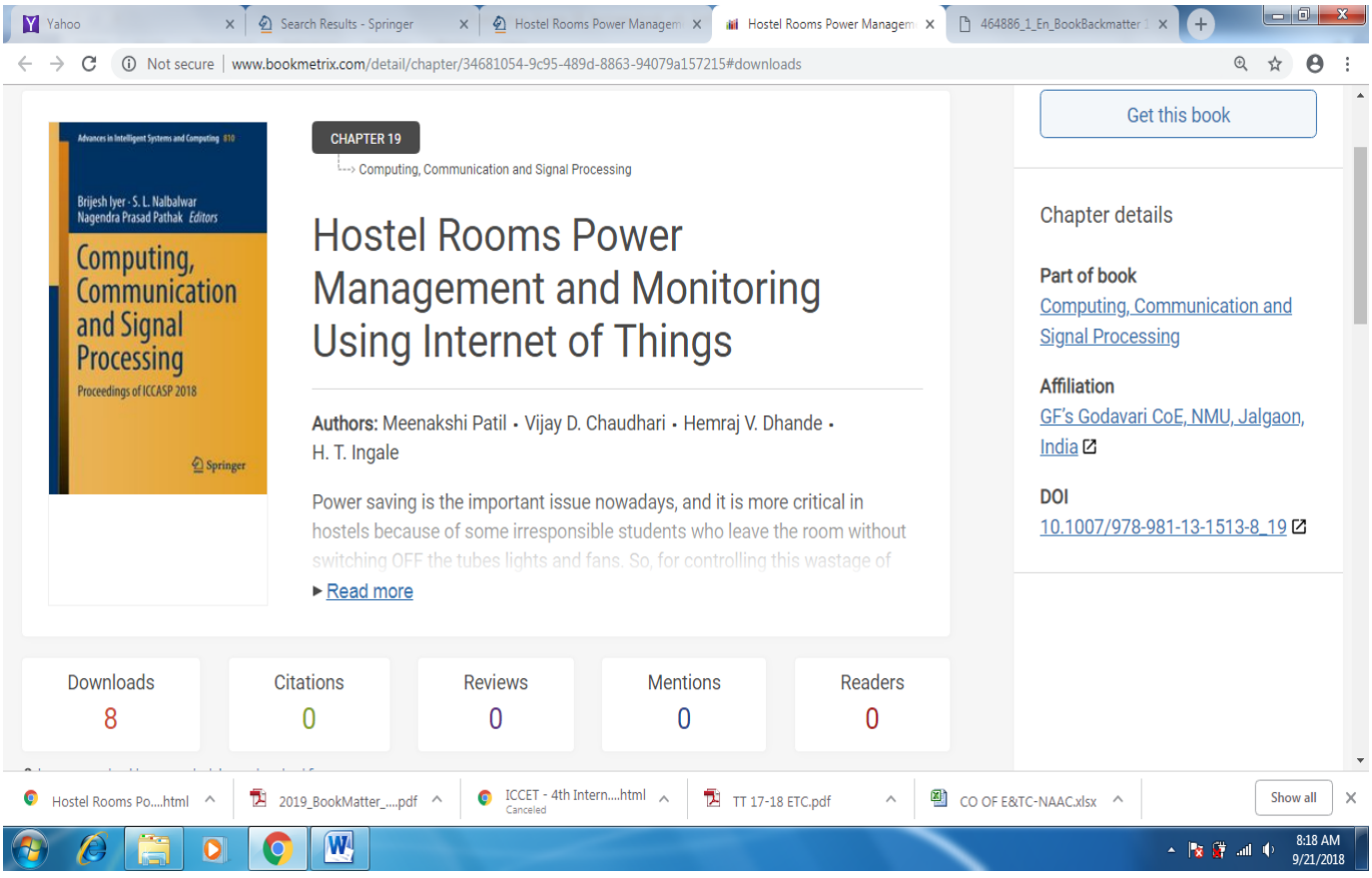

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CHAPTER 19

Computing, Communication and Signal Processing

Hostel Rooms Power Management and Monitoring Using Internet of Things

Authors: Meenakshi Patil · Vijay D. Chaudhari · Hemraj V. Dhande · H. T. Ingale

Power saving is the important issue nowadays, and it is more critical in hostels because of some irresponsible students who leave the room without switching OFF the tubes lights and fans. So, for controlling this wastage of

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A Review Paper on Experimental Investigation of Effect of Absorber Volume on Performance of Vapour Absorption Refrigeration System

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ABSTRACT

This paper focuses on the construction of a vapor absorption refrigeration unit, intended to operate in a 20^0c environment, with a compartment temperature of 3^0c. Gas absorption systems, unlike Vvapor-compression systems, use a heat source to facilitate refrigeration. Vapor absorption refrigerators use here electricity to heat the generator by an electric heater and 12 V DC motor pumps for delivering the aqua ammonia solution from absorber to generator. Unlike the vapor-compression cycle, which utilizes pressure gains and drops to produce refrigeration, the vapor absorption cycle uses the principle of partial pressure between two fluids to create the cooling effect. Extensive analysis of thermodynamics, heat transfer, and chemical properties of a two fluid absorption system was conducted to design and construct the structural model.The objective of this work is to design amonia water refrigeration system and what is the effect of absorber volume on Coefficient of Performance.

Keywords- Ammonia, absorber,coefficient of performance,concentration,vapour

I. INTRODUCTION

1.1 Objective of work

Development of water cooler using a Vapour absorption system based on water-ammonia as refrigerant and 500 watt air heater as heat source [2] that will represent the exhaust gas heat recovery, heat exchanger will be a modified spiral fin heat exchanger using cylindrical flat heat pipes for maximum heat recovery. The main aim is to find out coefficient of performance by preparing proper model of vapour absorption system by using generator, absorber, evaporator, pump, capillary tube etc. Experimental COP will be compared with theoretical. Later, volume of absorber changed and then what effect on COP takes place.

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1.2 Need of Project

Widespread efforts are currently underway to utilize available energy resources efficiently by minimizing waste energy and develop replacements for the traditional refrigerants (CFCs and HCFCs), which contributes to ozone depletion and greenhouse warming. Absorption chillers which are heat-powered refrigeration systems have got more and more attention, due to the recognition of rational utilization of energy and the concerns about ecological problem. The ammonia-water mixture is environmental friendly, which is the only working pair currently used for refrigeration purposes in absorption systems, and despite of the new mixtures under investigation, the ammonia-water mixture is the only one with a clear future. The principle of the absorption is providing the necessary pressure difference between the vaporizing and condensing processes, which alternately condenses under high pressure in the condenser by rejecting heat to the environment and vaporizes under low pressure in the evaporator by absorbing heat from the medium being cooled.

This paper helps in the development of water cooler using a vapour absorption system based on amonia as rerfrigerant and water as absorbent. 500 watt as air heater is used as heat source that will represent exhaust gas heat recovery. And accordingly we want to know that as per heat recovery how much quantity of mass flow of absorber volume will be send to generator so that we can get maximum coefficient of performance.

1.3 WORK

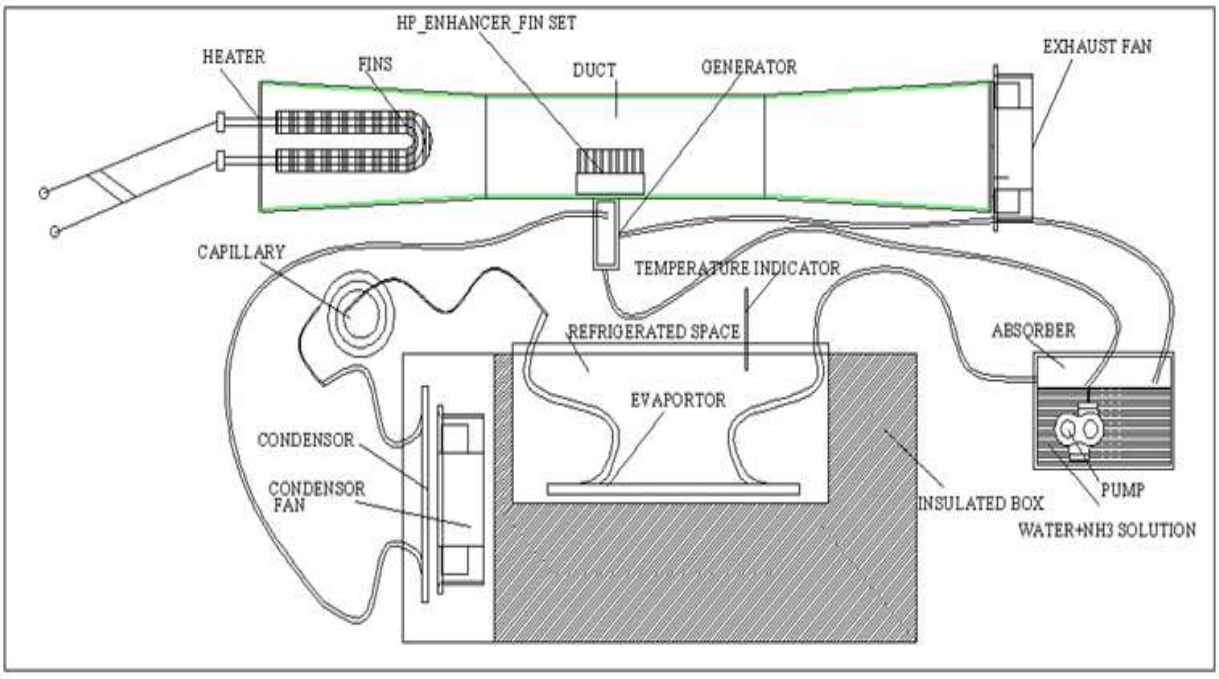

Fig1: Model Preview

$$COP = \frac{Q_e}{Q_g + W_p}$$

where,

Qe = Refrigerating effect,

COP = coefficient of Performance

Qg + Wp = Sum of work done by pump and generator

II. LITERATURE SURVEY

Various research papers has been reviewed for present work done in the field of Vapour Absorption syatem.

A- Trial on Vapour absorption refrigeration system by taking various proportion [1]

Harish Shingane,Arpitsingh Kanpuriya,Darshan Ranekar,Sachin Hakdale,AshishJumnake and Prof. Saurabh Rathod presented a paper on Experimental set up of vapour absorption refrigeration system by using NH3-H2O refrigerantwith various proportion. They observed that performance of NH3-H2O pair is good by maintaining proportions of ammonia and water. The range of C.O.P. for the aqueous ammonia system is (0.5 to 0.8) when the generator temperature is upto 60 ^{0}c. The range of minimum evaporator temperature is (25 ^{o}c to 30 ^{0}c). They increased quantity of ammonia step by step and decreased the quantity of water for each reading.

B-Trial of Cooling of a truck cabin by vapour absorption refrigeration system using exhaust gases heat [2]

Shekhar D Thakre, Prateek D Malwe, Rupesh L Raut, Amol A Gawali. They f ocused towards design and development of an air cooling system for cabin of truck using waste heat from exhaust. It means exhaust gas heat has so much potential that by using this heat we can cool truck cabin without any disturbance on engine performance of truck.

By reviewing above two papers and referring with reference book i found following research gap.

2.1 Research Gap

From study of above literature some points found that,maximum work were done by many authors regarding of experiments vapour absorption syatem using aqua amonia solution. Here main refrigerant is amonia and water as absorbent. We can set proper mass flow of absorber volume to circulate through syatem to get maximum coefficient performance.In my work i have not taken proportion of ammonia and water istead of I adjusted the mass flow of absorber volume and cop is calculated which will be benificial for society and young Engieers.

III. CONCLUSION

From literature review following conclusions can be drawn

1. Vapour absorption can be run on low grade energy.
2. This system is noiseless and pollution free.

3. For better working of vapour absorption system, the concentration of solution should be carefully studied because concentration difference is the main cause for mass transfer while temperature difference is the main cause for heat transfer.

IV. FUTURE SCOPE

In future we can use MINITAB software and optimization can be done for coefficient performance.

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EXPERIMENTAL INVESTIGATION OF VAPOUR ABSORPTION SYSTEM

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ABSTRACT

With the depleting energy resources recycling of waste energy or recovery of energy from the exhaust of processes or engine is vital method and important of energy conservation. Refrigeration another absolute requirement that needs to be catered, conventionally the vapour compression cycle is the preferred method but it comes with an handicap that the non-conventional energy resources cannot be employed to operate the same. The vapour absorption system using ammonia as refrigerant on the other hand is a method which can be used to harness this recovered process heat or heat carried by the exhaust gases of the engine.

The project aims at the design development analysis and performance evaluation of one such scaled system for volume size of 5 liters by utilization of vapour absorption system using ammonia as refrigerant. The paper includes experimental investigation of vapour absorption refrigeration system i.e. to find coefficient of performance of the system. Work includes the heat load calculation and design selection of components of system to suffice the requirements, The critical components of the system have been designed and developed using Unigraphix software and thermal analysis of the components has been done using Ansys Work bench 16.0.

Keywords: *Waste heat recovery, COP, Vapour absorption system, Ammonia, Thermal Analysis.*

1. INTRODUCTION

The vapor absorption refrigeration system comprises of all the processes in the vapor compression refrigeration system like compression, condensation, expansion and evaporation. In the vapor absorption system, the refrigerant used is ammonia, water or lithium bromide. The refrigerant gets condensed in the condenser and it gets evaporated in the evaporator. The refrigerant produces cooling effect in the evaporator and releases the heat to the atmosphere via the condenser.

The major difference between the two systems is the method of the suction and compression of the refrigerant in the refrigeration cycle. In the vapor compression system, the compressor sucks the refrigerant from evaporator and compresses it to the high pressure. The compressor also enables the flow of the refrigerant through the whole refrigeration cycle. In the vapor absorption cycle, the process of suction and compression are carried out by two different devices called as the absorber and the generator. Thus, the absorber and the generator replace the compressor in the vapor absorption cycle. The absorbent enables the flow of the refrigerant from the absorber to the generator by absorbing it.

Another major difference between the vapor compression and vapor absorption cycle is the method in which the energy input is given to the system. In the vapor compression system, the energy input is given in the form of the mechanical work from the electric motor run by the electricity. In the vapor absorption system, the energy input is given in the form of the heat. This heat can be from the excess steam from the process or the hot water. The heat can also be created by other sources like natural gas, kerosene, heater etc. though these sources are used only in the small systems.

2.OBJECTIVE

A) To find coefficient of performance of the system.

B) To compare the COP before changing the absorber volume and after changing absorber volume

3.ASSUMPTIONS BEFORE CONDUCTING THE EXPERIMENT

In this experiment following assumptions is made.
a .The vapour leaving the condenser is saturated at condenser temperature.
b .The strong solution leaving the absorber is saturated at absorber temperature.
c. The weak solution leaving the generator is saturated at generator temperature.
d. The strong solution is heated only up to saturation temperature, and no vapour generation takes place in the heat exchanger.
e. No pressure changes except through the pump.
f. The work input for the pump is negligible relative to the heat input in the generator. Therefore, the pump work is neglected for the purpose of analysis.
g. Steady state and steady flow.
.

4.EXPLAINATION OF MODEL AND OTHER PARTS

Fig.No.1-Three D Model of Vapour Absorption Refrigeration System

In this model absorber, generator, solution pump, condenser coil, evaporator coil, cabinet , thermostat ,small bulb as load, exhaust fan , cooling purpose condenser fan etc are the parts in this vapour absorption system.
First of all with the proper setting of thermostat heater is started then solution 12 V DC pump is started then as soon as pumps starts solution delivers to generator in which solution is heated . Heating of solution takes place due to indirect heating of air by air heater , air is sucked over generator and delivered to atmosphere. Here heated air is used to heat the generator. When heat is applied to strong solution the solution becomes weak and this weak solution send back to absorber vessel .Strong solution vapours generated send to condenser for conversion of vapour to liquid (due to condenser cooling fan temperature decreases hence conversion of vapour to liquid take place) This high pressure liquid funelling through capillary tube as expansion valve. Here due to Joule Thompson effect pressure decreases , such low pressure low temperature refrigerant passes in the cabinet where evaporator coil is placed it absorbs latent heat of air and thus the air is cooled. From evaporator this refrigerant is passed to absorber , here absorbent is kept water this water absorbs ammonia and thus the solution becomes strong and ready for further cycle.

4.1HEATER-

Heater is a single phase AC heater with 300 Watt power, provided with helical mild steel fins that improve heating ability of heater through enhanced heat transfer

Fig No. 2 Heater

The heater arrangement is used as an alternative to the exhaust system that is proposed in the above data. The air heater heats the air which then passes over the heater module using heat pipe mounted on the generator

4.2GENERATOR

The generator pipe receive rich water ammonia solution at the bottom via the pump, as the generator body is heated the vapours generated are sent to the condenser section via the top hole where as the lean water ammonia solution is sent back to the absorber via the central hole

Fig No. 3 Generator

4.2 EXHAUST FAN

Exhaust fan is 230 volt AC 4 inch span axial fan that pulls the hot air over the heat pipe module thereby heating the generator where in the ammonia vapours are produced to be sent to the condenser section.

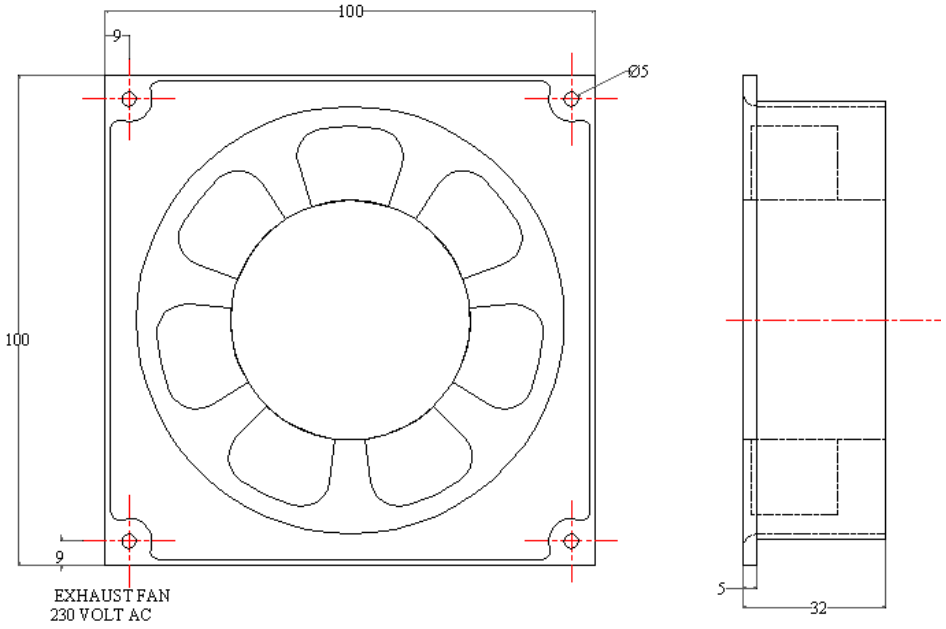


Fig No.4 Exhaust Fan

4.3DIGITAL TEMPERATURE INDICATOR

In our set up we have purchased total six digital temperature indicators for taking readings at six point such as temperature before generator , temperature after generator, evaporator temperature , condenser temperature, temperature before absorber, cabinet temperature. The sensor of temperature indicator is attached with teflon tape to evaporator tube , condenser tube and other tubes as shown in the figure below so that error remaining for temperature at six points is constant.

Fig No. 5 Digital Temperature Indicator

4.4 VOLTAGE REGULATOR- For experimentation we require voltage regulator for varying the absorber volume flow rate .In the following figure voltage regulator is shown.

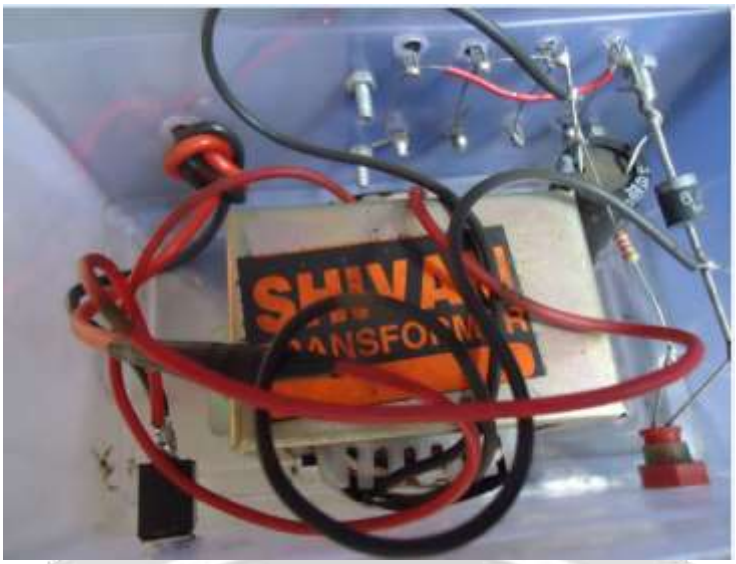


Fig No.6 VOLTAGE REGULATOR

The design of experimentation has given a road map of how the experimentation is planned but implementation of experimental plan and conduction of actual test run requires a systematic detailing of execution. Presentation of those details is the main substance of this paper. Keeping these points in mind this paper is divided into two main parts namely.

- Experimental procedure
- Observations.

5.EXPERIMENTAL PROCEDURE FOR BOTH CONSTANT VOLUME AND VARIABLE VOLUME

1.Switch ON the supply to the system and switch ON the main switch to start the heater
2. Check all the temperatures (i.e. 1, 2, 3, 4, 5, and 6)
3. Let the system run for some period (till the temperature in the evaporator tank starts decreasing)
4. Now note down the readings as per the observation table.
5. When cabinet temperature (T6) reaches around 15˚C, switch on variator. Adjust the load between 6 to 12 Volts. Ensure that the cabinet temperature does not increase when bulb is switched on.
6. If T6 increases, reduce the power supplied to bulb.
7. Note down 5 – 6 readings at interval of 5 minutes.
8. Calculate the results as per the calculation procedure.

5.1 Observation Table: For constant volume flow

Sr. No	T1 (^{o} C)	T2 (^{o} C)	T3 (^{o} C)	T4 (^{o} C)	T5 (^{o} C)	T6 (^{o} C)	V volt	I amp	POWER	TIME
01	31	34.6	18	31	29	21	12	1.2	14.4	10

TABLE NO.1

only one sample reading is given here for calculation purpose.

where T1: temperature before generator. , T4: condenser temperature

T2: temperature after generator T5: temperature before absorber

T6: cabinet temperature T3: evaporator temperature

5.2CALCULATION & RESULT TABLE

COP (Theoretical) = T3 (T2 – T5) / T2 (T5 – T3)
COP = $T_e (T_g-T_a) / T_g(T_a-T_e)$
For Reading No.1,
COP (Theoretical) = 18 x (34.6-29) / 34.6 (29-18) = 0.2648
COP (actual) = load applied / Heat supplied to generator
Load applied = V x I = 14. 4 w**att**
Heat supplied to generator = m* Cp * Δt
= 0.014 x 1.009 x 12 *0.3 = 50.85 watt
COP act = 14.4 / 50.85 =0.283

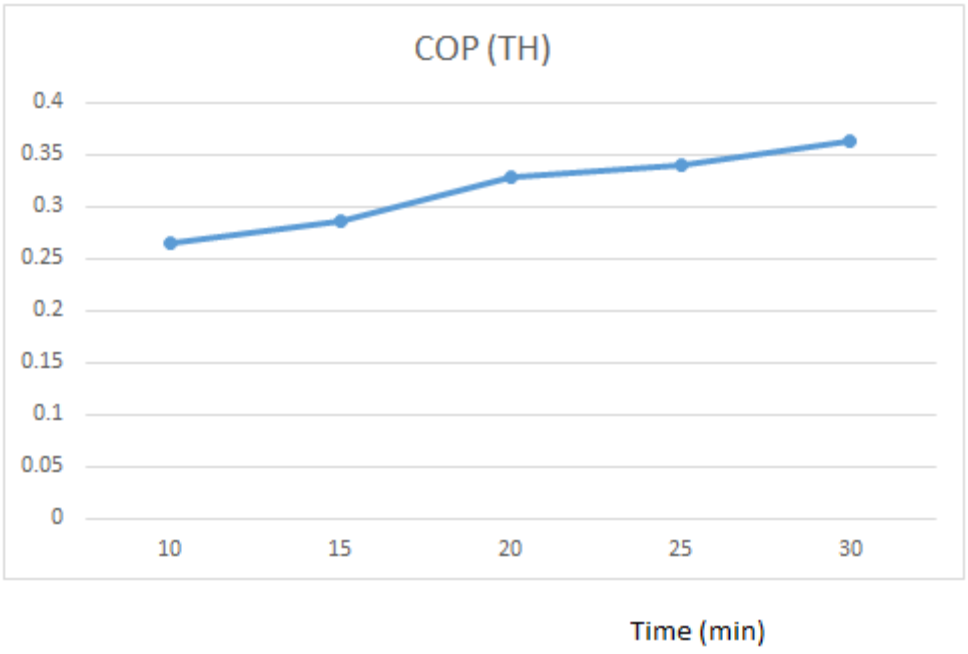
6.RESULTS AND DISCUSSION

A-For constant volume flow

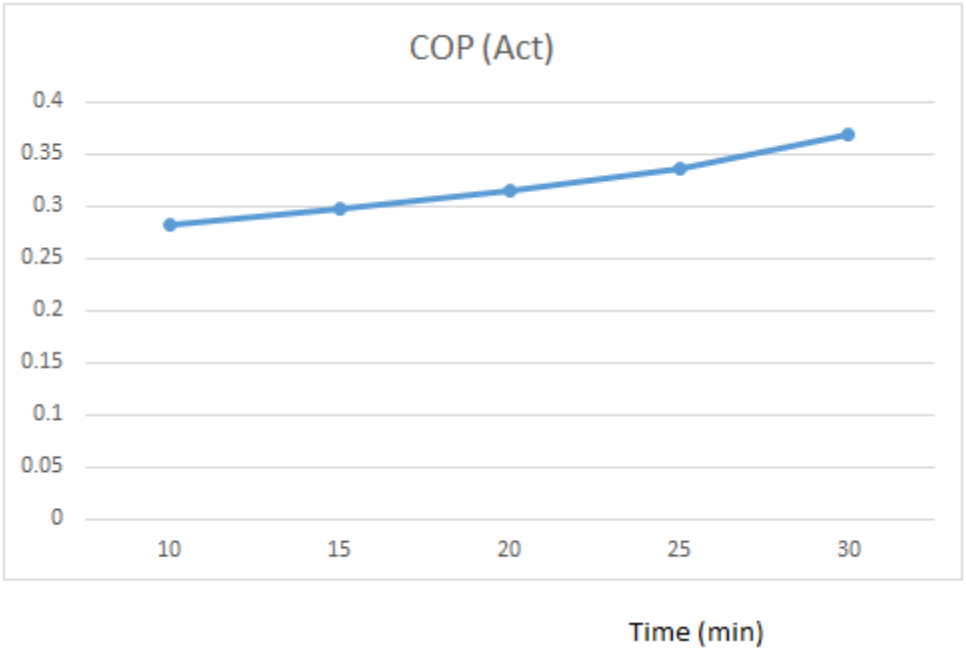
Sr.No	Time (min)	COP (Th)	COP (Act)
01	10	0.264844982	0.283166
02	15	0.285714286	0.298069
03	20	0.328638498	0.314629
04	25	0.340480145	0.336435
05	30	0.362907977	0.369347

TABLE NO .2

Graph of COP (theoretical) Vs. time

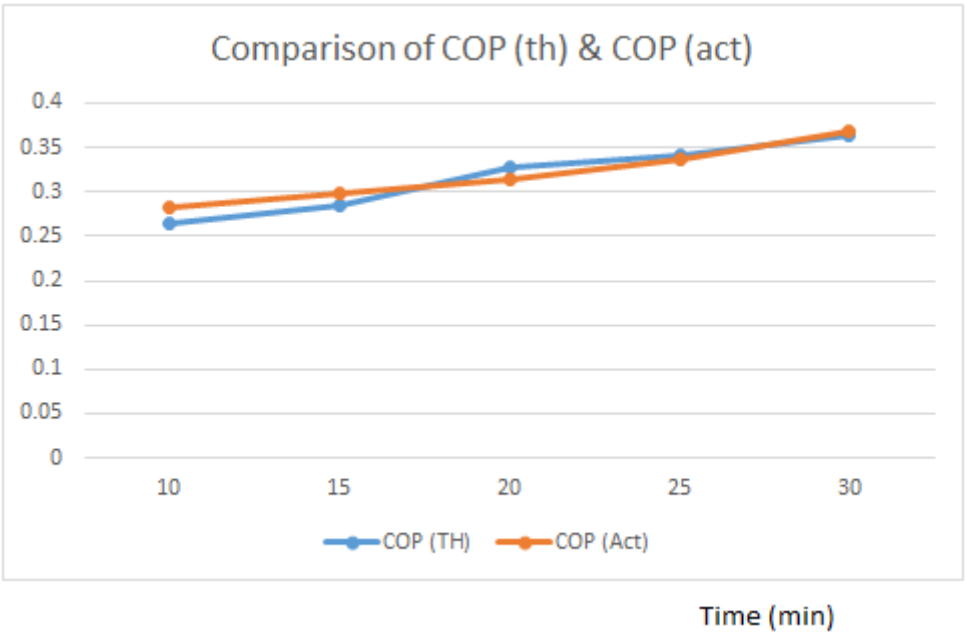


The theoretical COP of the system is seen to increase with time with maximum COP observed is 0.3629
Graph of COP (actual)Vs time



The Actual COP of the system is seen to increase with time with maximum COP observed is 0.3694 observed is 0.3694

Comparison Of COP(theoretical) and COP(actual)



7.0EFFECT OF CHANGE IN COP BY CHANGE IN ABSORBER VOLUME

In Vapour compression system we can check flow of refrigerant by using rotameter because compressor maintains flow of refrigerant flow through each part such as condenser , expansion valve and evaporator. In condenser state of refrigerant is liquid so refrigerant is always fitted after condenser outlet in vapour compression system. But our system is vapour absorption system so refrigerant flow is checked with the help of instruments as below.

Here flow rate is calculated by using stop watch . For one minute proper voltage is set then Liter per minute is find out. For full voltage full flow is observed similarly for haif of the voltage we get haif flow . In such a way we can find out mass flow of refrigerant.

Experimental Procedure:

1.Switch ON the supply to the system and switch ON the main switch to start the heater
2. Check all the temperatures (i.e. 1, 2, 3, 4, 5, and 6)
3. Let the system run for some period (till the temperature in the evaporator tank starts decreasing)
4. Now note down the readings as per the observation table.
5. When cabinet temperature (T6) reaches around 15˚C, switch on variator. Adjust the load between 6 to 12 Volts. Ensure that the cabinet temperature does not increase when bulb is switched on.
6. If T6 increases, reduce the power supplied to bulb.
7. Note down 5 – 6 readings at interval of 5 minutes.
8. Calculate the results as per the calculation procedure.

Observation Table: For variable volume flow

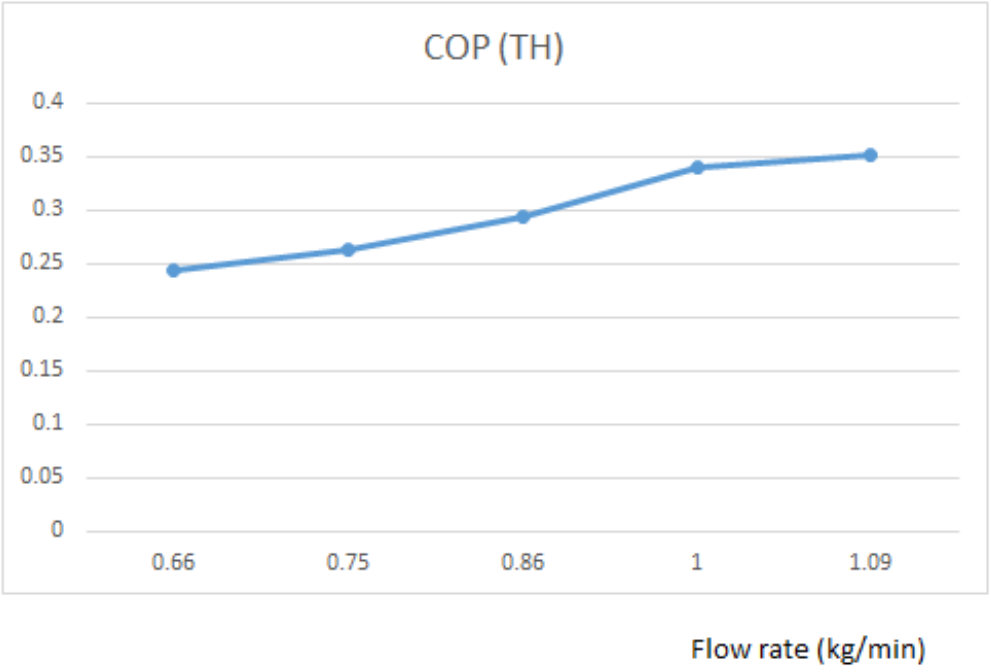
Sr. No	Flow rate of pump (kg/min)	T1 (^{o} C)	T2 (o C)	T3 (o C)	T4 (o C)	T5 (o C)	T6 (o C)	V volt	I amp	POWER
01	0.66	32	34.6	19.4	31	30	26	12	1.2	14.4

RESULT TABLE

Flow rate (kg/min)	COP (Th)	COP (Act)
0.66	0.243319882	0.255488
0.75	0.262400331	0.269682
0.86	0.293254262	0.287965
1.0	0.340480145	0.329902
1.09	0.352071897	0.357683

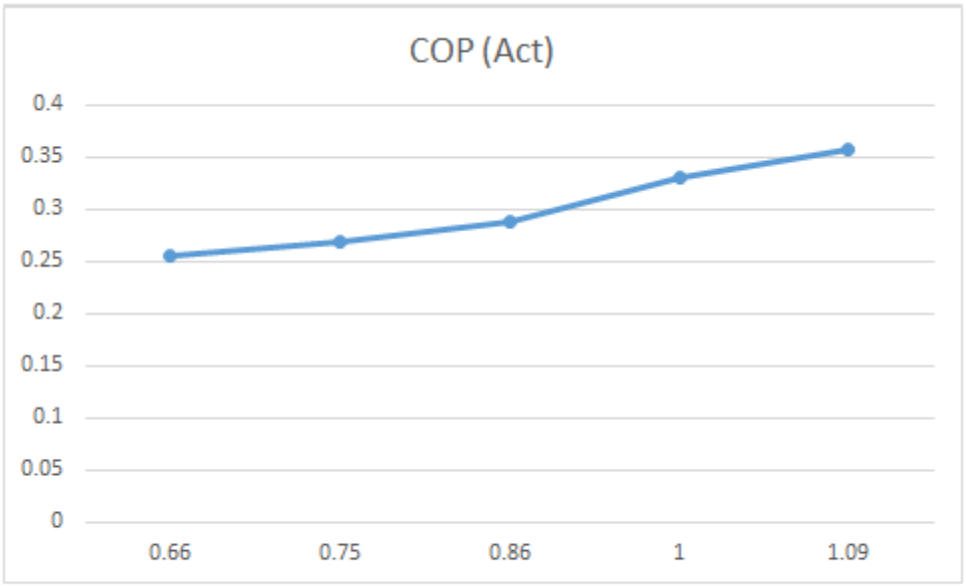
Here calculation for variable volume flow COP is calculated as in previous process.

Graph of COP (Theoretical) Vs Flow rate (kg/min)



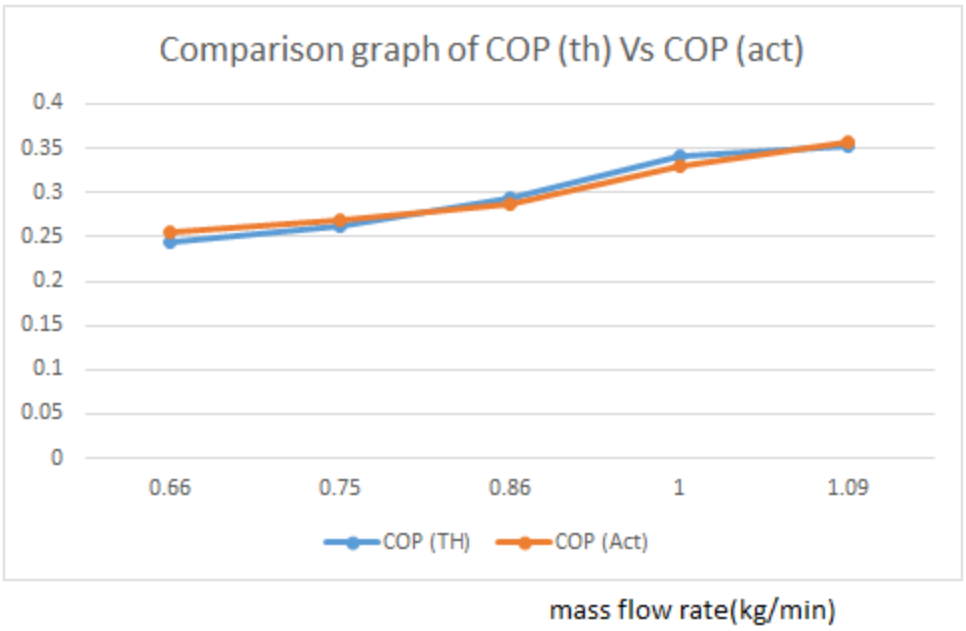
The theoretical COP increases with the increase in the flow rate

Graph of COP (actual) Vs Flow rate (kg/min)



The actual COP increases with the increase in the flow rate

Comparison Of COP(theoretical) and COP(actual)



The comparison of COP (theoretical) and COP (actual) shows that they are in close agreement indicating that the experiment is validated

It is seen that the ideal COP of an absorption system is the sole function of temperatures at which reversible energy transfer takes place. In addition , the expression for COP indicates that there is a fictitious heat engine which works between the generator and absorber temperatures, and a fictitious heat pump works between the evaporator and absorber temperatures.The fictious work output of the heat engine is used to execute the heat pump.

8.SCOPE FOR FUTURE WORK

This system is designed to reduce the impact of emmission mandating using HCFCs or CFCs as refrigerants to the atmosphere and to preserve perishable goods. However , the system is limited to only electrical power source. Hence, it is recommended that other sorces of powering the machine (solar, waste heat, etc) should be encouraged for further studies to improve its operation and performance. It is also proposed that high aluminium pipe materials should used as the condenser. This will increase the capacity of the generator thus speeding up the heating process of the system.

1.Closed loop circuit can be developed to link pump flow and refrigerating effect.

2.Multiple generator sets can be used to improve the performance of system

3.System can be made hybrid by use of Peltier modules in circuit that will increase the refrigerating effect.

4.Scope for future work is to include analyzer,rectifier and working fluids hydrogen to convert the strong solution into weak solution and to facilitate the faster rate of evaporation in the evaporator in vapour absorption system.

9.CONCLUSION

Keeping in mind the environmental safety point of view , this system is eco-friendly as it involves the use of ammonia (a natural gas) as a refrigerant and is not responsible for green house effect and Ozone layer depletion.

NH3-H2O is the most suitable working fluid due to its high latent heat and excellent heat and mass transfer properties.Ammonia absorption technology has great potential to offer economical and innovative solutions to various refrigeration requirements. Absorption machine theory has existed for many years, however just recentely this technology has reached a stage where it is also a commercially viable option. The small capacity application potential of ammonia absorption refrigeration technology makes it a strong candidate for the refrigeration technology of the millennium

1.For good performance the value of L/D should be less than one i.e. the ratio of lift to depression is less than one then the system is said to be performing good.And in my experiment for each reading the value of L/D is less than one.(Refer following table for L/D)

2.The Theoretical COP of system increases with the increase in time.

3.The actual COP of system increases with increase in time.

4.The Theoretical COP of system increases with the increase in flow rate.

5.The actual COP of system increases with increase in flow rate.

Sr. No	T1 (^{o} C)	T2 (^{o} C)	T3 (^{o} C)	T4 (^{o} C)	T5 (^{o} C)	T6 (^{o} C)	Lift =L (T2 – T5)	D=Depression (Ta-Te)	L/D
01	31	34.6	18	31	29	21	5.6	11	0.51

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[1] Harish Shingane,Arpitsingh Kanpuriya, Darshan Ranekar, Sachin Hakdale, Ashish Jumnake and Prof. Saurabh Rathod. Experimental set up of vapour absorption refrigeration system by using NH3-H2O refrigerant with various proportion, *IJARIIE-ISSN(O)-2395-4396,vol-3Issue-2,2017*

[2] Shekhar D Thakre, Prateek D Malwe,Rupesh L Raut, Amol A Gawali,Cooling of a truck cabin by vapour absorption refrigeration system using engine exhaust, *IJRET,eISSN:2319-1163IpISSN:2321-7308*

BOOK

1.A course in Refrigeration and Air-Conditioning by Domkundwar, Arora.

BIOGRAPHIES

A.G.Patil has received the B.E. Mechanical Engineering degree from Institution of Mechanical Engineers (India) Mumbai. Now, pursuing M.E.in Mechanical with specialization in Thermal Engineering from Godavari College of Engineering, Jalgaon which is affiliated with North Maharashtra University, Jalgaon in Maharashtra State (India)

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Design of Generator in Vapour Absorption refrigeration System

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ABSTRACT

With the depleting energy resources recycling of waste energy or recovery of energy from the exhaust of processes or engine is vital method and important of energy conservation. Refrigeration another absolute requirement that needs to be catered, conventionally the vapour compression cycle is the preferred method but it comes with an handicap that the non-conventional energy resources cannot be employed to operate the same. The vapour absorption system using ammonia as refrigerant on the other hand is a method which can be used to harness this recovered process heat or heat carried by the exhaust gases of the engine. The project aims at the design development analysis and performance evaluation of one such scaled system for volume size of 5 liters by utilization of vapour absorption system using ammonia as refrigerant. The project work includes the heat load calculation and design selection of components of system to suffice the requirements, The critical components of the system have been designed and developed using Unigraphix software and thermal analysis of the components has been done using Ansys Work bench 16.0.

Keywords: Waste heat recovery, Engine exhaust, Vapour absorption system, Ammonia, Thermal Analysis.

INTRODUCTION

The vapor absorption refrigeration system comprises of all the processes in the vapor compression refrigeration system like compression, condensation, expansion and evaporation. In the vapor absorption system, the refrigerant used is ammonia, water or lithium bromide. The refrigerant gets condensed in the condenser and it gets evaporated in the evaporator. The refrigerant produces cooling effect in the evaporator and releases the heat to the atmosphere via the condenser.

The major difference between the two systems is the method of the suction and compression of the refrigerant in the refrigeration cycle. In the vapor compression system, the compressor sucks the refrigerant from evaporator and compresses it to the high pressure. The compressor also enables the flow of the refrigerant through the whole refrigeration cycle. In the vapor absorption cycle, the process of suction and compression are carried out by two different devices called as the absorber and the generator. Thus, the absorber and the generator replace the compressor in the vapor absorption cycle. The absorbent enables the flow of the refrigerant from the absorber to the generator by absorbing it.

Another major difference between the vapor compression and vapor absorption cycle is the method in which the energy input is given to the system. In the vapor compression system, the energy input is given in the form of the mechanical work from the electric motor run by the electricity. In the vapor absorption system, the energy input is given in the form of the heat. This heat can be from the excess steam from the process or the hot water. The heat can also be created by other sources like natural gas, kerosene, heater etc. though these sources are used only in the small systems.

EXISTING METHOD

The existing methods use an electric heater or fuel burners as the heat source to the generator system. This is extra energy that has to be added to the system that brings down the COP of the system.

PROBLEM STATEMENT

With the depleting energy resources recycling of waste energy or recovery of energy from the exhaust of processes or engine is vital method and important of energy conservation. Refrigeration another absolute requirement that needs to be catered, conventionally the vapour compression cycle is the preferred method but it comes with a handicap that the non-conventional energy resources cannot be employed to operate the same. The vapour absorption system using ammonia as refrigerant on the other hand is a method which can be used to harness this recovered process heat or heat carried by the exhaust gases of the engine.

Widespread efforts are currently underway to utilize available energy resources efficiently by minimizing waste energy and develop replacements for the traditionally refrigerants (CFCs and HCFCs), which contribute to ozone depletion and greenhouse warming. Absorption chillers which are heat-powered refrigeration systems have got more and more attention, due to the recognition of rational utilization of energy and the concerns about ecological problem.

The ammonia-water mixture is environmental friendly, which is the only working pair currently used for refrigeration purposes in absorption systems, and despite of the new mixtures under investigation, the ammonia-The principle of the absorption is providing the necessary pressure difference between the vaporizing and condensing processes, which alternately condenses under high pressure in the condenser by rejecting heat to the environment and vaporizes under low pressure in the evaporator by absorbing heat from the medium being cooled.

Presently very few systems are in existence that works to recover the exhaust gas energy and harness it for refrigeration purpose.

SOLUTION

The vapour absorption system using ammonia as refrigerant on the other hand is a method which can be used to harness this recovered process heat or heat carried by the exhaust gases of the engine.

The paper aims at the design development analysis and performance evaluation of one such scaled system for volume size of 5 liters by utilization of vapour absorption system using ammonia as refrigerant. The project work includes the heat load calculation and design selection of components of system to suffice the requirements, The critical components of the system have been designed and developed using Unigraphix software and thermal analysis of the components has been done using Ansys Work bench 16.0.

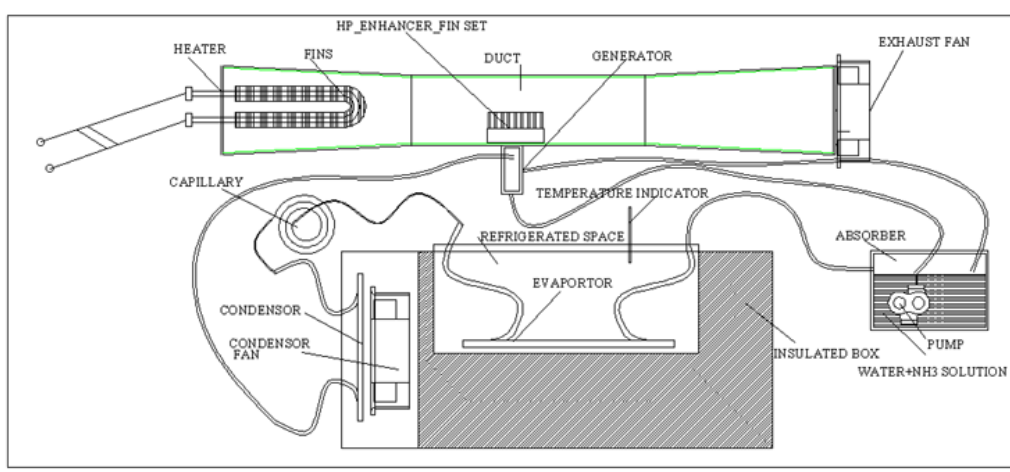
The performance evaluation of the system has been done by experimental test and trial and the COP of the system has been calculated at various flow rate of the refrigerant. The optimization is further done using Minitab software to predict the optimal flow rate so as to attain the maximum temperature gradient.

OBJECTIVES

A) Heat load calculation to determine the overall cooling load and thereby determination of the total cooling capacity of the system.

B) Design Selection and Analysis of System components to satisfy the desired cooling capacity and thus justify the selection of the components.

Schematic of Vapour absorption system utilizing waste heat recovery mixture is the only one with a clear future



Heat load calculation

Heat load calculation to determine the overall cooling load and thereby determination of the total cooling capacity of the system

Cooling load calculation

Transmission load

Q = U x A x (Temperature out – Temperature in) x 24 ÷ 1000.

QT = 0.019 kWh/day ----------this is the load due to infiltration of heat

Product load – Product exchange

Q = m x Cp x (Temperature enter – Temperature store) / 3600.

Qp = 0.040 kWh/day

Product load – Product respiration

Q pr= m x resp / 3600

Qpr = 0.010 kWh/day

Total cooling load

To calculate the total cooling load we will just sum all the values calculated = 0.019+ 0.040

Total Heat load = 0.06 Kwh /day

Safety Factor

We should also then apply a safety factor to the calculation to account for errors and variations from design. It's typical to add 10 to 30 percent onto the calculation to cover this, We have assumed with 60% in this example so well just multiply the cooling load by a safety factor of 1.6 to give us our total cooling load of 0.096 kWh/day

Refrigeration cooling capacity sizing

The last thing we need to do is to calculate the refrigeration capacity to handle this load, a common approach is to average the total daily cooling load by the run time of the refrigeration unit. For this I am estimating the unit to run 24 hours per day which is fairly typical for this size and type of store. Therefore our total cooling load of 0.096 kWh/day will sufficiently meet this cooling load ---rounding off to 0.1 kwh as total heat load.

Converting the total heat load to Power result in watt

Power requirement equivalent to 0.1 kwh for 24 hours = 4.2 watt

Thus, the design of the equipment components will be done for 4.2 watt

Design and selection of heat recovery system components

As the aim of the project is develop a scaled prototype to test and prove the application of waste heat recovery we have taken the approach to create the effect of waste heat recovery artificially heated air by use of heater thus the primary part would be selection of the heater.

The arrangement of the generator heat source using heat pipes and air heater (that resembles the exhaust gas heat recovery) is as follows:

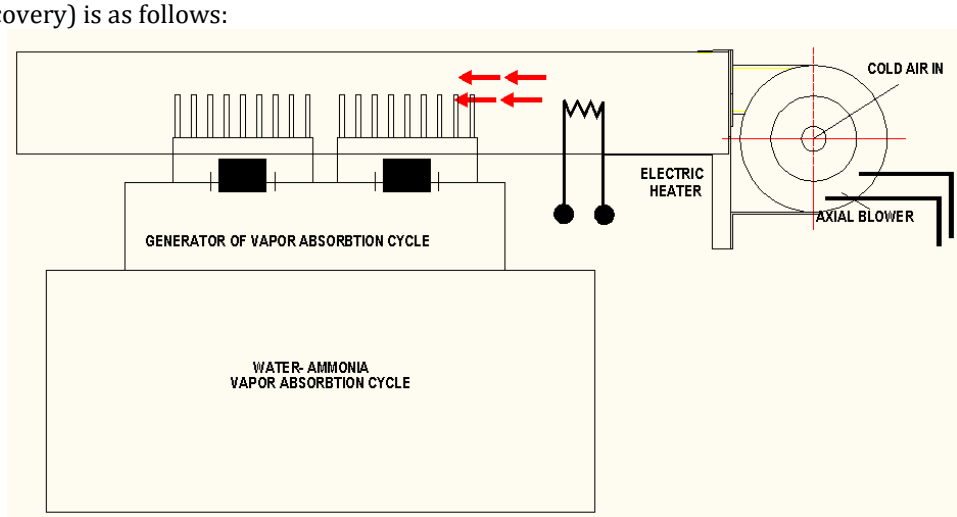


Fig- Generator heating with heat pipes

Input data:

Refrigeration load = m CP Δ T = 4.2 watt

Refrigeration load = heat rejected = m CP Δ T = 4.2 x 60/1000 = 0.252 K cal/min

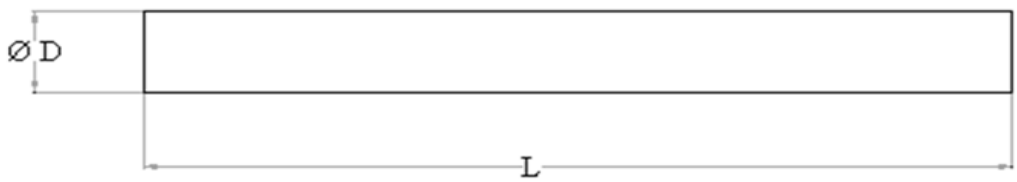
Actual heat supplied = Refrigeration load/ Actual COP = 0.252 /1.49 = 0.17 Kcal /min

Coversion of Kcal/min = 0.17 Kcal/min x 60 = 102 Kcal/hr to wattage is done using convertor from;
102 Kcal/hr = 118 watt
Assuming a factor of safety = 2
Hence selecting a 300-watt air heat assuming around 50 % thermal efficiency of the finned heat pipe system.

DESIGN AND ANALYSIS OF FIN SYSTEM FOR EFFECTIVE HEAT RECOVERY HEAT PIPE GEOMETRY-SIZE SELECTION

Heat pipes are available in standard diameters from 3 to 12mm and in lengths from 50mm to 250 mm, shape is as shown in figure below:

HEAT TRANSFER CAPABILITY FOR ABOVE HEAT PIPE



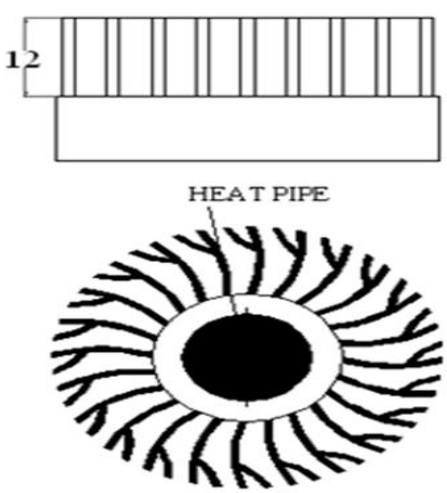
Standard Diameter –D = 32mm , Standard length = L= 12mm ,Material = Copper
Cooling Fluid = Sintered copper powder ,Tolerance for Dia = (+0.00,-0.05)Tolerance for Length = (+0.5, -0.5)

MAXIMUM WATTS AT DIFFERENT TEMPRATURE

DIAMETER	20^0C	30^0C	40^0C
32 mm	64 WATT	96 watt	120 watt

- The power handling figures are for heat pipe working in horizontal position.
- Length 12 mm long
- Evaporator length 5mm
- Condenser length = 5mm
- Adiabatic length =2mm
- Sintered Copper Powder

SPIRAL RADIAL HEAT PIPE FIN ENHANCER



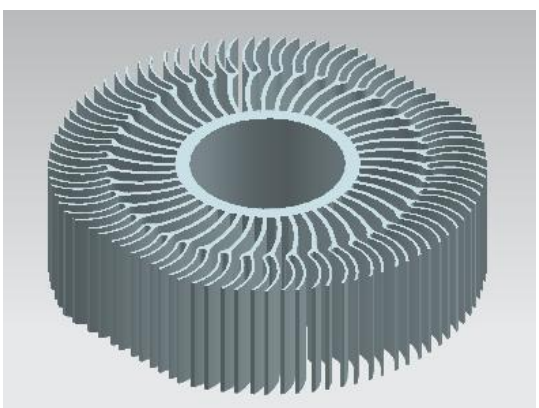
Overall width (W)=100mm ,Gap between fins (d) =5mm, Length = 100mm,Width = 3mm,height of fin =12mm,Number of fins =56, Heat pin fin set no =1Surface area = A=0.256 m^2,Heat Pipe= Wick Structured Sintered Copper,Working Fluid = Water

DESIGN OF FINS STRUCTURE

Material of fins aluminium (thermal conductivity K) = 225 W/m^0c
Perimeter of fin system P = π x d = 3.142 x 0.1 = 0.3142 m
Area of c/s of fin structure = 0.03142m^2

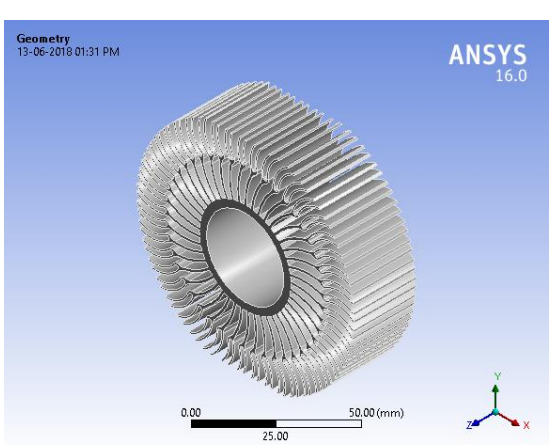
Fin base temperature = 65 ^{o}C
Fin tip temperature = 40^{o}C
Convective heat transfer coefficient (h) = 20 W/m^{2o}C
Heat transfer from the fin system is given by ,
Q = k A m (ΔT) ---------- neglecting fin efficiency
Q = 225 *0.03142 *m * (65-40) ----------(65-40) is the temperature difference
Where m = Sq.rt (h *P / K*A) = sq. rt (20 x 0.3142 / 225 x 0.03142) =0.94
Thus,
Q = 225 * 0.03142 * 0.94 * (65-40)
Q = 166 .13 Watt
Assuming fin efficiency to be 80 %
The actual heat transfer possible by the fin structure = 166.13 *0.8 = 132 Watt
As the Heat transfer by fin system (132 Watt)> the heat rejected by the heater system (118 watt) the selected fin structure arrangement is safe.

ANALSYSIS OF FIN :

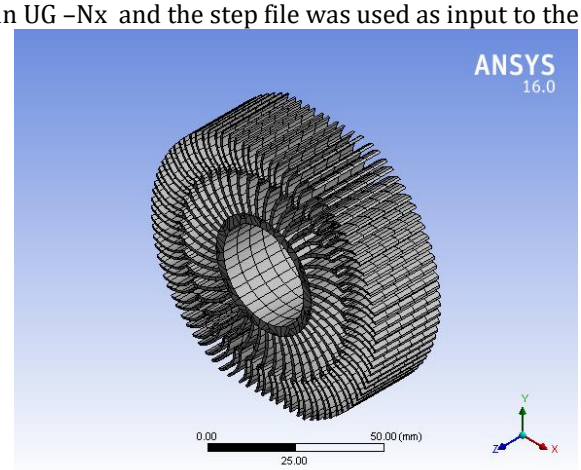


Measurement Mass Properties
Displayed Mass Property Values
Volume = 44370.921173957 mm^3,Mass = 0.118026650 kg
Weight = 1.157447095 N, Radius of Gyration = 31.867822937 mm
Centroid = -0.000882324, -0.001446557, -13.000000000 mm
==========
Detailed Mass Properties
Analysis calculated using accuracy of 0.990000000Information Units kg – mm
Density = 0.000002660,Volume = 44370.921173957,Area = 102813.439157077
Mass = 0.118026650

Considering heater of 300 watt the heat flux = 0.07 watt /mm2
Geometry

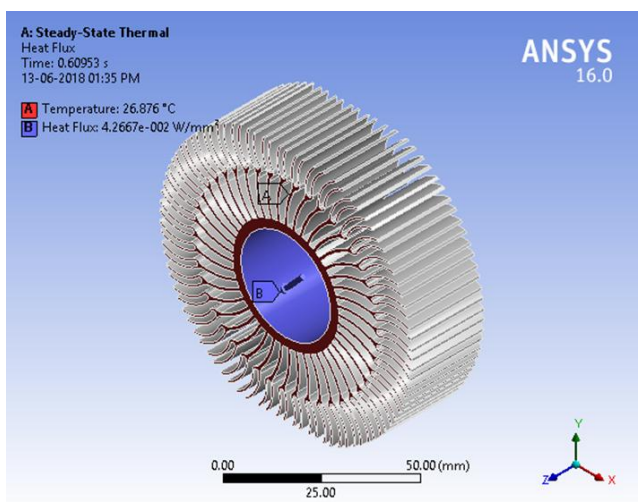


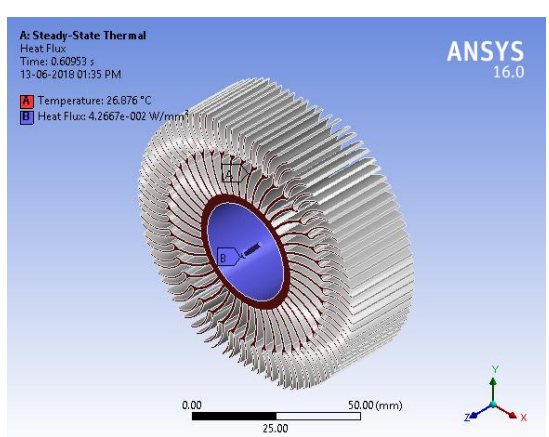
Geometry was developed in UG –Nx and the step file was used as input to the Ansys.



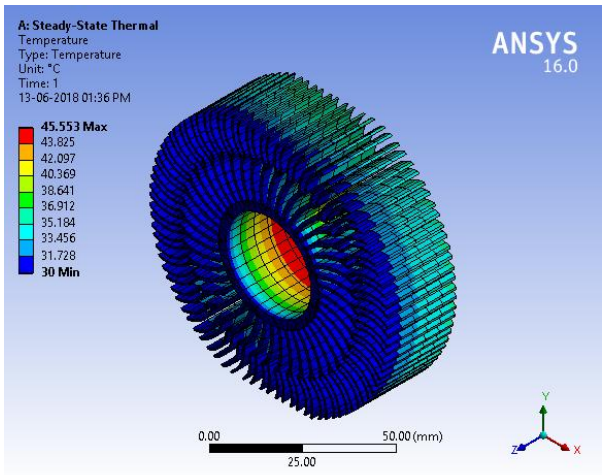
Meshing was done using Ansys free mesher and the parameters found were as below

Statistics	
Nodes	41347
Elements	5570
Mesh Metric	None

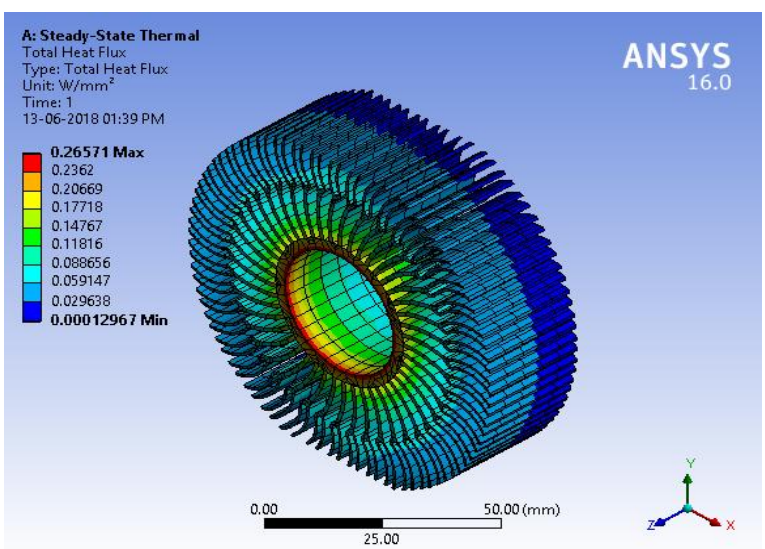




The heat flux of 0.07 watt/mm^2 was applied at the heat pipe end where the fins are exposed to ambient temperature of 30 degree.



The figure above shows the temperature distribution across the fin structure with maximum temperature at the heat pipe end indicating that the generator end will receive the maximum temperature gradient and thereby evaporate the ammonia as desired function in the generator



The figure above shows that the maximum heat flux is 0.26571 indicating that maximum heat is transferred to the working fluid i.e. ammonia ,thus the system will effective act as generator given the high performance of the fins.

Conclusion :

1. Heat load calculations were performed for the refrigeration system and the cooling capacity requirements were found to be o.1 Kwh /day
2. The heater unit was selected of 300 Watt which can easily generate the heat requirement of 118 Watt which is required for development of desired refrigeration effect in the system
3. he fin selection done for the generator section showed good temperature distribution and total heat flux of 0.26571 watt /mm2 against the requirement of 0.07 watt/mm2.
4. The system component thus selected is apt to get desired refrigerating effect.

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BOOK

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