ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

Design And Implement Smart Shelter by Using Recycled Plastic.

IETP Final Report

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ADDIS ABABA ETHIOPIA

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Acknowledgement

We would like to express our sincere appreciation to everyone who contributed to the successful development of the prototype for the Smart Shelter project. This milestone was made possible through the dedication, hard work, and support of many individuals.

Firstly, we would like to thank our project sponsor Addis Ababa Science and Technology Universty for their financial support and guidance throughout the development of the prototype. Without their generous contributions, this achievement would not have been possible.

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Thank you all for your invaluable contributions to the successful development of the Smart Shelter prototype. Your efforts have brought us one step closer to creating a better, more sustainable future for all.

Executive Summary

This project is meant to solve the effectiveness of the provision of shelter to refugee and emergency camps in an easy & cost-effective way, at the same time helping the environment by recycling plastics. This is done by providing a space suitable for the targeted user and providing effective smart shelter system that is advantageous to the user. Because of the flexible and smart nature, we integrated into it, it can be applied in different locations and scenarios.

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Chapter One: INTRODUCTION

1.1 Background

Around the world, there are tons of plastic wastes produced, that could be recycled and used for different types of purposes. And at the same time there are millions of homeless refugees and people in need of medical care that lack a proper shelter, in each part of the world. Rather than letting plastics end up somewhere where they hurt the environment, we decided to use them to satisfy the need for shelter in different types of areas in an affordable manner.

The main purpose of our project is to design an affordable and easily planted smart shelter that is to be made from recycled plastic wastes, and also capable of smart actions. This shelter would be designed in way that could be adapted and used for different purposes and applications like refugee camps, emergency camps and military camps, mean while we wanted to work on the rarely touched topic, which is providing refugees a shelter and make a very useful project for our world by also reducing the plastic wastes produced around the world.

The shelter will also be able to take shrewd measures to help those who are disabled and in need of medical attention, since we designed it with the idea of being smart and adaptable in mind, we have integrated a feature that creates a smart communication system between user and service provider for the camp. At the same time, because it has the potential to be linked with one another, it can be utilized as a straightforward cabin or piled sideways as much as necessary to provide additional usable space. It will be powered by a solar panel which means it could be used in a remote place as well.

All these features integrated to it, in-return, makes it even more desirable to be used in different areas and scenarios.

1.2 Problem Statement

According to the UNHCR, at least 89.3 million people around the world have been forced to flee their homes. Among them are nearly 27.1 million refugees, around half of whom are under the age of 18. But, building a shelter needed for refugees seems to be expensive and even impossible to afford for some countries, for especially the developing ones, since the cost even for a typical refugee camp is between $5 million and $10 million dollars. Which is creating difficulties for refugees in finding adequate shelter. Not only that in recent year in spread of COVID-19 quarantine was the biggest challenge for both developing and developed countries because, building a suitable quarantine zone needed more infrastructure and more time.

Meanwhile, Aaccording to the UN environment program report, over 380 million metric tons of recyclable plastic are being produced yearly. Also a research estimates that, of the 8.3 billion metric tons that has been produced, 6.3 billion metric tons has become plastic waste. Of that, only nine percent has been recycled. The vast majority—79 percent—is accumulating in landfills or sloughing off in the natural environment as litter. Meaning: at some point, much of it ends up in the oceans, the final sink.

So, to reduce all this chaos happening in the world, we wanted to invest our time and knowledge on this project idea that could potentially solve both the problems that we listed earlier.

1.3 Objective

1.3.1 General Objective

The General objective of the project is to design and implement affordable, nature friendly, moveable, smart, easily produced and used shelter that would benefit those who are in need of it within a short period of time using a recycled plastic.

1.3.2 Specific Objective

- Designing a shelter that uses recycled materials as its form.
- Provide a means of smart communication system between user and service provider for the camp.
- Design the parts of the shelter using a technique that would make them easy to dismantle and join together.
- Create an easy manufacturing process for the parts.

1.4. Scope and Limitation of the project

1.4.1 Scope

- Addressing the shelter problem found in every part of the world by designing a shelter that can adapt different types of environments and also can be adapted to be used for various types of scenarios and uses,

- Using a recycled plastic to construct its basic form, which at the same time helps us to address the plastic waste management problem currently rising around the world.
- Even though, on this specific project, we focused on adapting the shelter to be used for refugee and emergency camps, by simply adding some simple gadgets to it, it could also be adapted to be used as a shelter for military camps, storage facility, medical centres, a research centre for remote areas, construction camp and even for different types of campaigns like blood donation campaigns, advertising campaigns... and even more.

1.4.2 Limitation

Budget and time limitations

As a participant in the process building the project the time and budget limit are main limitations for us.

Devices and materials limitations

Even though the main material we will be using is a recycled plastic, getting all the right devices and materials needed for melting, moulding and producing the parts we wanted is also another limitation we have.

Design and research limitations

The other limitation we have is we have to create a shelter that is fit for different environments and context, which needs a lot of research in determining which types of plastics we should recycle and use. And also, designing it with such a flexible nature questions the integrity during harsh environmental conditions.

1.5 Significance of the Project

This project is important because it manages to solve 2 of the main problems that our planet is facing. Simultaneously, it will achieve solving the problems in a cheaper and affordable way, making the solution faster and easier to apply for every country in the world. This is achieved by the recycled plastic used for production and the smart systems integrated to it.

To relate with SDGs, our project can satisfy more than 6 goals which might be linked directly or indirectly. Here are the directly related ones

Water goal: - focuses on conserving and sustainably using our oceans, seas and marine resources for sustainable development and preventing marine pollution. As we stated in our problem statement, the main pollutants of the oceans are plastic wastes. Our project focuses on creating a use for the waste Plastics that could have ended up polluting the ocean otherwise.

Climate Action: - Climate action is a goal involving the fight against climate change caused by rising greenhouse gas emissions and its impacts. Meanwhile, Plastic recycling reduces the need to extract new raw materials from the earth as it reuses the stuff that's already processed and protects natural resources. This can help reduce emissions of heat-trapping gases into the atmosphere.

Responsible Consumption and Production: - Ensuring sustainable consumption and production patterns, as a goal, aims to reduce climate change and negative environmental impacts by reducing waste and managing chemicals and waste in an environmentally responsible way. Our project has created a way to manage an environmentally friendly way to manage waste plastics.

Sustainable Cities and Communities: - This goal promotes making cities and human settlements safer, resilient, sustainable and also providing protection for the poor and vulnerable from death by natural disasters by providing safe and affordable housing for all. Our project aims for providing the needy with affordable and easily manufactured shelter.

Responsible Consumption and Industry, Innovation, and Infrastructure: - Resilient infrastructure, inclusive and sustainable industrialization, and innovation is the objective of this sustainable development goal. This project has also integrated smart systems that is inclusive for disabled people to ease their life during their time in the shelter.

Good Health and Well-Being: - this goal targets ensuring healthy lives and promoting well-being for all ages by ensuring universal health coverage and access and reducing pollution and contamination deaths. The smart plastic shelter has the ability to be adopted as an hospital (extension), emergency camp and medical and research centre, providing an affordable health facility to all in need.

Chapter Two: Literature Review

"Smart Shelters: A Review of Technologies and Applications" by R. G. S. Sahin, et al., published in the Journal of Civil Engineering and Architecture in 2016, is a literature review that examines the various technologies and applications of smart shelters. The authors of the study define smart shelters as structures that are equipped with various technologies, such as sensors, internet connectivity, and energy-efficient systems, to enhance their functionality and improve the lives of those who use them. The study found that smart shelters can provide a range of benefits, including energy efficiency, environmental monitoring, remote control, additional services, and communication and collaboration. However, the authors also note that implementing smart shelters poses several challenges, including high cost of technology and infrastructure, lack of standardization, and need for effective data management and privacy safeguards. The authors conclude that smart shelters have the potential to provide safe, comfortable, and sustainable housing, as well as a range of other services, to individuals and communities in need. However, more research and development is needed to address the challenges of cost, standardization, data management, and privacy, to ensure that these shelters can be implemented effectively and sustainably.

"The Smart Shelter: A Vision for the Future of Disaster Response" by D. G. Krantz, et al., published in the Journal of Homeland Security and Emergency Management in 2013, is a literature review that focuses on the potential of smart shelters to improve disaster response efforts. The authors argue that traditional emergency shelters, such as tents and trailers, have several limitations, such as lack of privacy, poor living conditions, and dependence on external resources, that can be addressed by using smart shelter technology. The study found that smart shelters can provide a range of benefits, including self-sustainability, comfort and safety, remote monitoring and control, rapid deployment, and communication and collaboration. However, the authors also note that implementing smart shelters poses several challenges, such as high cost of technology and infrastructure, lack of standardization, and need for effective data management and privacy safeguards. The authors conclude that smart shelters have the potential to revolutionize disaster response by providing self-sustaining, comfortable, and secure housing for individuals and communities affected by disasters. However, more research and development is needed to address the challenges of cost, standardization, data management, and privacy, to ensure that these shelters can be implemented effectively and sustainably.

"Design and Development of Smart Shelter for Disaster Management" by P. K. Jain, et al., published in the International Journal of Advanced Research in Computer and Communication Engineering in 2016, is a literature review that examines the design and development of smart shelters for disaster management. The authors of the study define smart shelters as structures that are equipped with various technologies, such as sensors, internet connectivity, and energy-efficient systems, to enhance their functionality and improve the lives of those who use them. The study found that smart shelters can provide a range of benefits, including real-time monitoring, remote control, energy efficiency, communication and collaboration, and GIS-based management. However, the authors also note that implementing smart shelters poses several challenges, including high cost of technology and infrastructure, lack of standardization, and need for effective data management and privacy safeguards. The authors conclude that smart shelters have the potential to provide safe, comfortable, and sustainable housing, as well as a range of other services, to individuals and communities in need. However, more research and development is needed to address the challenges of cost, standardization, data management, and privacy, to ensure that these shelters can be implemented effectively and sustainably.

"Smart Shelters for Disaster Relief: An Overview of Current Research and Development," a literature review published in the Journal of Disaster Research in 2019, examines the current state of research and development on smart shelters for disaster relief. These structures, equipped with technology such as sensors, internet connectivity, and energy-efficient systems, aim to improve functionality and the lives of users. The study found potential benefits such as self-sustainability, enhanced comfort and safety, real-time monitoring, rapid deployment, and improved communication and collaboration. However, it also highlights challenges such as high costs, lack of standardization, and need for effective data management and privacy safeguards. The authors conclude that while smart shelters have the potential to revolutionize disaster relief, further research and development is needed to address these challenges and reach a consensus on the definition and technology of these shelters.

Chapter Three: Methodology

3.1 Theory

We can create a shelter with the ability of easily assembly and disassembly by designing special type of joint that would allow each walls to be mounted to each other with out losing structural strength

We will use all types of recycled plastic wastes (except for pvc) to make the over all shelter structure by using some metals for additional strength and also add some sand to the recycling process to have a better temperature resistance in-case of using the shelter in hot areas. And the fact that we are using plastic material means that we will also achieve a light weighted product at the end.

We will be able to create a smart control and communication system between the user and shelter to enable the user to have control over the shelter's Lighting system and temperature control and have a live feed back about the temperature of the room.

Our shelter will have a flame detector that would help detect fire in case of an accident and it will notify the user as well as others by a hazard light.

By creating this shelter, we will achieve some SDG goals we have listed above and benefit the people in need of a shelter.

3.2 Methodology for the overall structural part

Material usage

Since the whole shelter is removable our whole material usage will take into consideration of using light and easy to dismantle materials. At the same time these materials would be durable for long term usage and strong enough to withstand the weather conditions. This will define the type of plastic we will recycle.

How they are made

The parts would be made by melting a waste plastic into a custom-made mould that will give the shape we desire. The moulds will be made up of woods and metal sheets and since most of the parts we will produce will be the same type, we could use the mould multiple times during the production.

Joints

The joints will also be moulded with the parts together creating a robust and durable structure that could also satisfy the easy assembly and disassembly process of the shelter. This joint will be designed in way that they could supply multiple use: - support the parallel side part (for extending and partitioning the shelter) and also support their perpendicular side part (at the ending of the side wall).

Space design

The space design will focus on providing the necessary space needed for one client. This is done by providing a space for bed, medical equipment, ventilation system, circulation space and form that responds to the surrounding context. Then this designed space will be used to determine the other extensions that the shelter will have when necessary. The usage of sloped roofs is better to provide a space for solar panels and also will be ideal for rainy environments. The wall part will also have a mounting space for different devices used in it depending on for what service it will be used.

3.3 Methodology for the overall Electrical parts and software features of the shelter.

Over all controlling mechanism

Since Arduino boards can send and receive message from a device to control another device attached to them.and they are affordable and easy for use, we will use them as our controlling device to control all the other components by an order that would be given from a cell phone or another device.

Air conditioning system

We will be controlling the air conditioning system with either a remote-control system or by an automated system that could sense the surrounding to detect the temperature and apply the necessary action. These orders would be given by some part of the code integrated with the Arduino board.

Light Control

The light is controlled by LAN and by sensing the darkness of the environment. There are switches to control the flow of electric current through the wire and this switch is controlled by the board and the code integration.

Alert system

This part includes some coding and electrical parts to perform its task, that will be uploaded to the Arduino board. The coding part would be integrated with the sensors and the Arduino board to detect the fire and alert the admin to take further action. And for the military purpose, it could also be used to alert a fellow soldier if danger is near.

Solar system

This part of the shelter would be responsible for powering the entire shelter using the sun light gathered by the solar panels that would be fitted to the shelter. A battery will also be fitted to store the energy for later use.

Wiring

All of the electrical wiring would be inserted inside the wall parts of the shelter in a way that is insulated. They will have a connection port at the end of each structural part which would help the shelter to be disassembled easily without damaging the wire system.

3.4 Beneficiaries of the project

The Environment

By managing and reusing waste plastic, the environment can benefit because of the reduction of waste plastics and other greenhouse gases used to produce them.

The disabled

Since an any camp is a place with a huge probability of having disabled people, our shelter has integrated a smart feature that could benefit those people with disabilities by easing their life in the shelter.

Countries with refugees

Since countries are the ones that provide the refugees with their supplies and shelter directly or indirectly, our project can relieve some amount of burden for the countries (especially the developing ones) by providing them an easily mounted, inclusive and cheap shelter for refugees.

Countries with a natural and man-made disaster

Those countries with disaster happening in them could use this project to provide a shelter for their citizen affected by it by a short period of time with an affordable price.

The military

The military of any country can use this project to build an easily assembled and dismantled, affordable, easily accessible and adaptable shelter for their military during peace keeping or other services done by the military out of the main camp.

Medical centres

Medical centres could adapt and use this project for building an economical shelter for the use of research centre, quarantine zone, extension of a hospital during an over flow of patients, and more.

3.4 Market and Business Analysis for Smart Plastic Shelter

Business Analysis

A. Market Analysis:

The market for affordable housing solutions for homeless people is significant and growing. According to the National Alliance to End Homelessness, there were approximately 580,000 homeless people in the United States in 2020. The pandemic has also exacerbated the issue, leading to a surge in homelessness. Therefore, the demand for affordable housing options is high, creating a significant market opportunity for the Smart Plastic Shelter project.

The Smart Plastic Shelter project's primary target audience is local governments, nonprofit organizations, and social entrepreneurs interested in addressing homelessness in their communities. The project's unique selling proposition (USP) is its eco-friendliness and affordability, making it an attractive option for those who want to provide sustainable housing solutions for homeless people.

B. Competitive Analysis:

Several companies offer affordable housing solutions, including modular homes and container homes. However, these options may not be as environmentally friendly as the Smart Plastic Shelter project. The project's use of recycled plastic and solar panels sets it apart from other affordable housing options. Moreover, the Smart Plastic Shelter project offers a unique solution to the problem of homelessness, making it stand out from other solutions.

Economic Analysis

The Smart Plastic Shelter project's economic feasibility depends on several factors, including the cost of materials, manufacturing, transportation, and installation. The use of recycled plastic makes the project eco-friendly and cost-effective. However, the cost of solar panels may increase the project's overall cost. The project's revenue will primarily come from the sale of the shelters to local governments, nonprofit organizations, and social entrepreneurs. The price of the shelters will depend on several factors, including the materials used, the size of the shelter, and the additional features. The project's operating expenses will include manufacturing costs, transportation costs, and installation costs. The project will also have marketing and administrative expenses, such as website maintenance and customer support.

Chapter Four: Engineering Analysis

4.1 Architectural Engineering Analysis

The smart shelters have the ability to serve several purposes before, during, or after a hazard occurrence sets it apart from other structures. A smart shelter's principal function from that of a normal building is its emergency shelter function is primarily important.

This Project focuses on two types of shelters: short-term shelters, which can only be occupied for a week or so during an emergency, and long-term shelters, which serve as a place to stay for longer events and during the recovery period after a disaster. Both typologies have various and similar design alterations and construction specifications.

Certain design alterations are required for dealing with the threat in order for a structure, whether it is new or existing, to act as a smart shelter. A building's architecture needs to be altered so that it can withstand all flood forces or be protected from floods in other ways. Spatial requirements, which refer to the amount of floor space needed for shelter space and supply storage, and infrastructural requirements, which refer to the level of self-sufficiency and the assurance that the building can operate as much as possible during an emergency event, are the two categories into which the functional requirements of smart shelters can be divided.

Design Methodology

The smart shelter type will dictate the required
functions for the shelter

The design **Concept** is based on the smart shelter type which will dictate the required functions for the shelter.

A short-term shelter's primary purpose is to offer a safe haven inside the danger zone to those who are unable to leave the affected area in time. Short-term shelters are inhabited for the length of the event plus the amount of time it takes from when people check in to when the event really begins. This period might not go above a week for temporary shelters. The functioning of a long-term shelter is largely equal to that of a short-term shelter, other than the duration of the occupancy.

Functional Requirement

Buildings will have several additional requirements to be able to function as a smart shelter. During normal circumstances smart shelters will have their primary function. But in times of emergency smart shelters change their function. These requirements can be categorized in the following: spatial requirements (floor area for refugees and storage) and infrastructural requirements (sanitation, drinking water, sewage, power supply, ventilation and communication) in order to be self-sufficient during Emergency.

In order to determine the capacity of shelters we must define the spatial requirement per refugee. Taking all consideration recommending the following minimum floor areas. These criteria are based on use of the shelter both as a refuge area during the event and as a recovery center after the event:

- 20 square feet/1,86 m^2 per person for a short-term stay (i.e., a few days)
- 40 square feet/3,72 m^2 per person for a long-term stay (i.e., days to weeks)

More floor space is required for the storage of supplies, such as beds, food, and water, as well as for additional installations required to ensure the facility has access to electricity, water, ventilation, and sanitation.

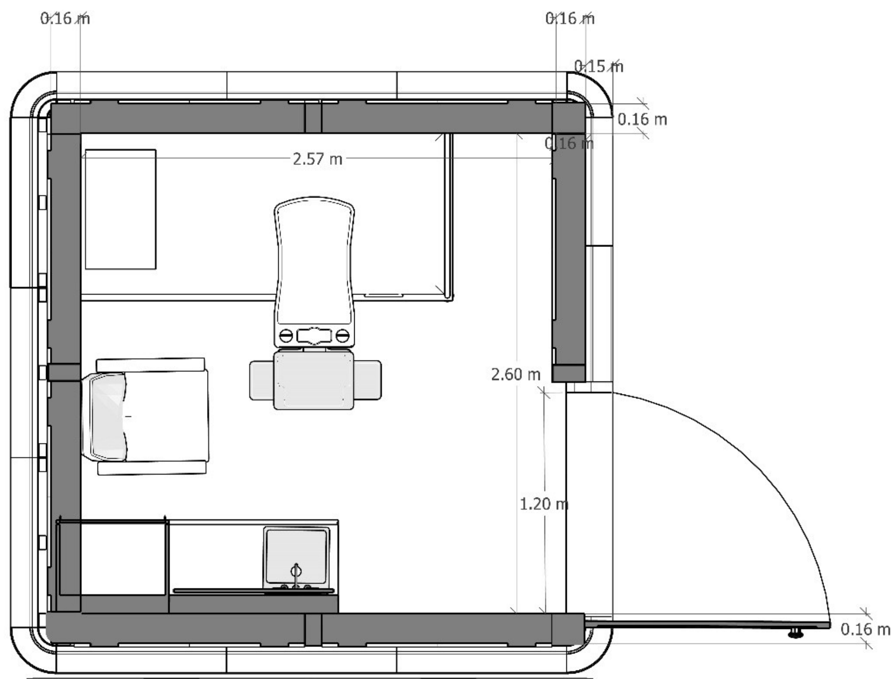
Single and Multiple

Stakeholders will need to make a decision on whether to construct and maintain one larger shelter or several smaller shelters dispersed around the hazard region in order to develop the most effective and efficient smart shelter approach. The spatial distribution of land use, flood risk maps, evacuation plans, and demographic information will define the quantity and capacity of necessary smart shelters, as well as the need for shelter. There are advantages and disadvantages to having to construct and maintain one or more shelters, but the essential requirement is that the shelter must be accessible during the warning period.

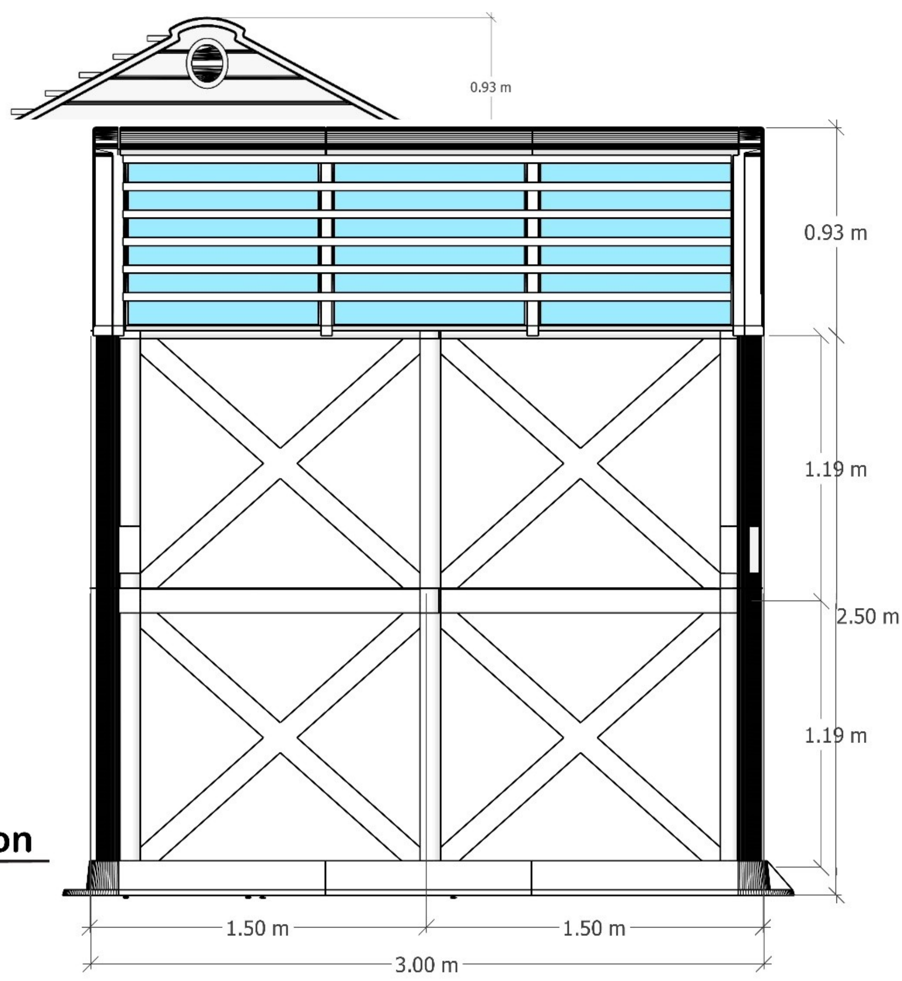
By dispersing smart shelters throughout the city, the population's ability to reach the shelter in time during an emergency will be significantly increased. In expansive urban regions with high population densities or urban areas with lower population densities, this is preferred. Refugees must arrive at the shelter in a timely manner, which is based on the warning periods as well as the infrastructure and transportation options that are available. Less smart shelters or just one will result in lower construction and maintenance expenses.

Final Drafted Design

The following design is a sample shelter design for one user. This design is specifically for a medical refugee taking into consideration of space usage by one person and furniture arrangement.



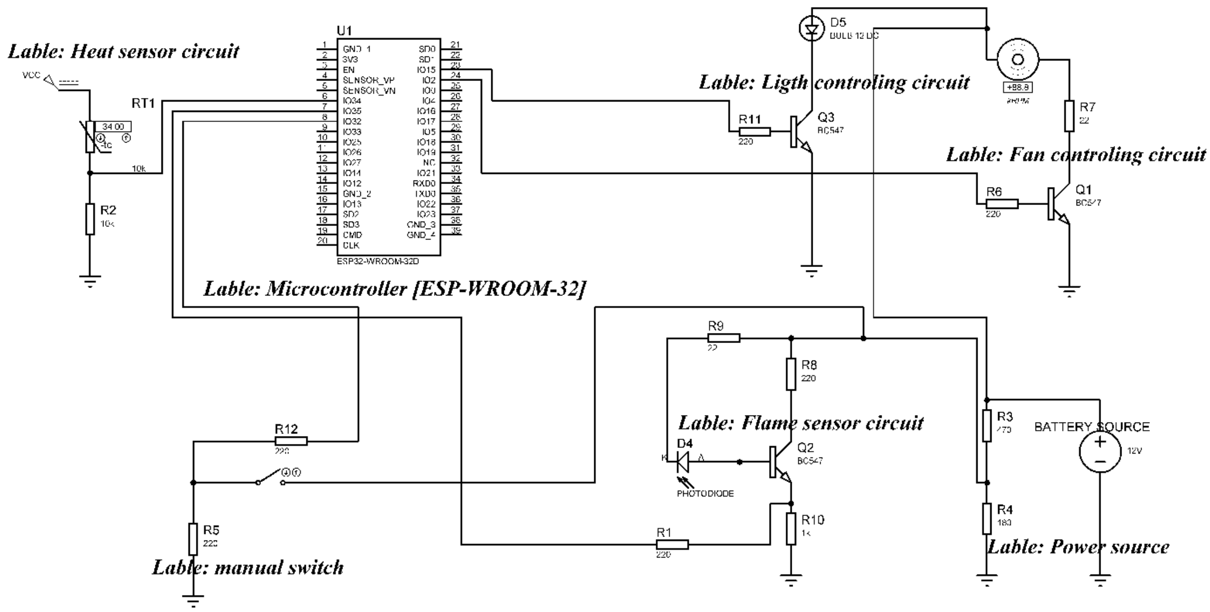
Floor Plan



Side Elevation

4.2 Electrical Engineering Analysis

4.2.1 Circuit Design



Overall Elctrical Crcuit

Figure 1 Circuit Design

4.2.2 Selection of Components

Heat sensor circuit

Thermistors: in above circuit we have choose 10kohm and β value 3380 because it can be found easily on the market and it meet our goal of project.

Steinhart–Hart equation will be used to convert the resistance value in to equivalent temperature.

Resistors: *10k ohm* series with *thermistors* used as shown in above circuit due to our microcontroller need analog voltage not resistance, by that reason voltage divider is used in the circuit.

Microcontroller

ESP-32: since our project is use networking interface for communication purpose, we need networking device.

This module consists Wi-Fi and Bluetooth connection methods so, we take advantage of this to make communication device with our device and client for emergency and to take control device.

Light controlling circuit

BJT: this transistor is used as switch, when our controller sends high voltage signal it accept it in it base then will *turn on* bulb.

Resistors: 220-ohm resistors are used for limiting the current that pass in base. So, it will protect the BJT.

Bulb: since we use dc power source, we choose 12-volt dc LED bulb, which is brighter.

Fan controlling circuit

BJT: this transistor is used as switch, when our controller sends high voltage signal it accept it in it base then will *turn on* fan.

Resistors: *220-ohm* resistors are used for limiting the current that pass in base. So, it will protect the BJT. And *22-ohm* is used to block current that pass in to collector of the bc547. when fan start it will draw 90mamp which quit close maximum rating of I_c of the BJT transistor which is 100mamp so this will reduce to 65mamp.

Fan: 12-volt DC Fan will be used to reduce the heat level of the room.

Manual switch

Resistors: Leaving the digital input pin floating connected into voltage is pretty bad, because it'll pick up a lot of noise and the GPIO (ESP-32 pin) digital logic read units won't be sure if it's a 0 or 1. Therefore, we need to do either a pull-up or a pull-down with a *220 resistor*. And the other *220 resistor* used as current limiting in to Arduino input.

Flame sensor circuit

Photodiode: is used to detect there is flame or not. Since a type of optical detector suitable for use as a flame detector because of their high sensitivity to light, fast response time, and low cost. Additionally, photodiodes are relatively easy to configure for flame detection applications due to their simple design.

BJT: this transistor is used as switch, when there is current flow due to photodiode start operate in revers mode by the reason of flame detection. So, there will be voltage drop from emitter resistance to ground.

Resistors: It'll be a dead short from emitter point to GND, if we did not put resistors. By this reason *1k ohm* was chosen. *220ohm* is used to limit current passing in to collector. *22ohm* to limit current passing in to base.

Power source

Resistors: since we need 12 volt and 3.3 volt for operation. We need to use voltage divider. So, the resistance chooses by using two criteria [power dissipation and current passing]. In terms of power dissipation means if use larger resistance there would more power dissipation, this power will be loos in terms of heat. And if use small resistance current will not pass to main circuit since current always choose less resistance. So, using this criterion we choose 470ohm and 180ohm to be voltage divider it also standard on the market.

4.2.3 Simulation Result

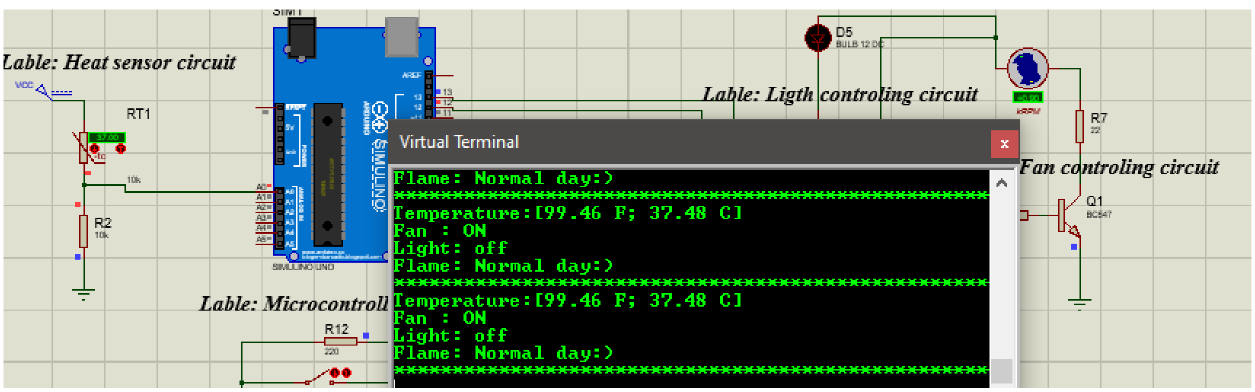


Figure 2 when the temperature is above 35 the fun is running

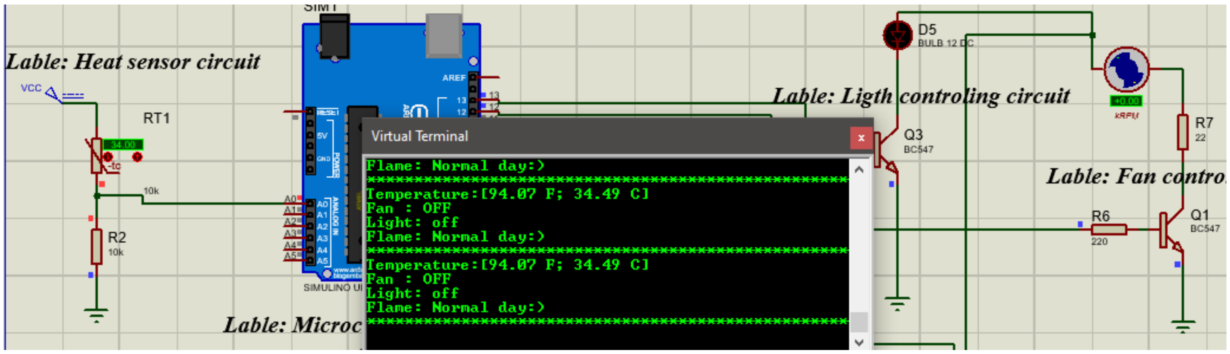


Figure 3 When temperature is lower than 35 the fun is not running

Chapter Five: Work plan

5.1. Responsibilities

5.1.1 Mechanical, Civil and Architectural Engineers Team

These Team will be responsible for designing and modelling the overall structure, foundation and mechanical part of the project.

Leul: - As an Architectural Engineer, my contribution in this project is designing the interior space for the shelter and also design the overall form of the shelter with the appropriate materials usage since the space must have all of the necessary spaces for the required program. I will also make sure the shelter has not been damaged by any external factor, like wind or water flow, or by any other means by choosing the right material for the structure to be built, collaborating with my team.

Kaleb: - As a Civil Engineer, i study the foundation part and overall structure of the smart shelter, oversee the construction and assembly process of the smart shelter, perform tests on materials and procedures to ensure suitability and compliance and ensure that the project is completed on time and within budget collaborating with my team.

Dagmawi: - As an Electro-mechanical Engineer, my role would be more of creating harmony between the work of the Electrical & Software Engineers team and the Mechanical, Civil and Architectural Engineers team. I will be collaborating with the Mechanical, Civil and Architectural Engineers team on designing the overall form of the shelter to make sure the shelter would be able to integrate all the smart system components that are to be done by the Electrical & Software Engineers team, Meanwhile I will also be closely working with the Electrical and Software Engineers team to make sure that every component and feature they design would fit in to the shelter. As I'm the one related to the mechanical engineering, I will also be working the mechanical part of the project which is, designing a joining component for the parts of the shelter to give it the ability of easy assembly and disassembly, collaborating with my team.

5.1.2 Electrical and Software Engineers Team

This team will be responsible for designing and integrating all the smart features and communication systems for the shelter.

Bewketu: - As a Software Engineer, I will be participating in the coding part which is used to integrate the system with an Arduino board which can be controlled from another device. That means in I will be working on the code for integrating the air conditioning system, the light system and fire alert system with the Arduino board to be controlled with another device.

Adnan: - As a Software Engineer, working on this project, we are not only modernizing the shelter, but also modernizing the service. Provide systems and issue systems that allow users to be efficient. For example, as a form of communication in cases of urgent need that may arise for medical purposes, or to alert you to suspicious activity when used for military purposes. So, my part will be coding and designing a means of communication and control system for the shelter collaborating with my team.

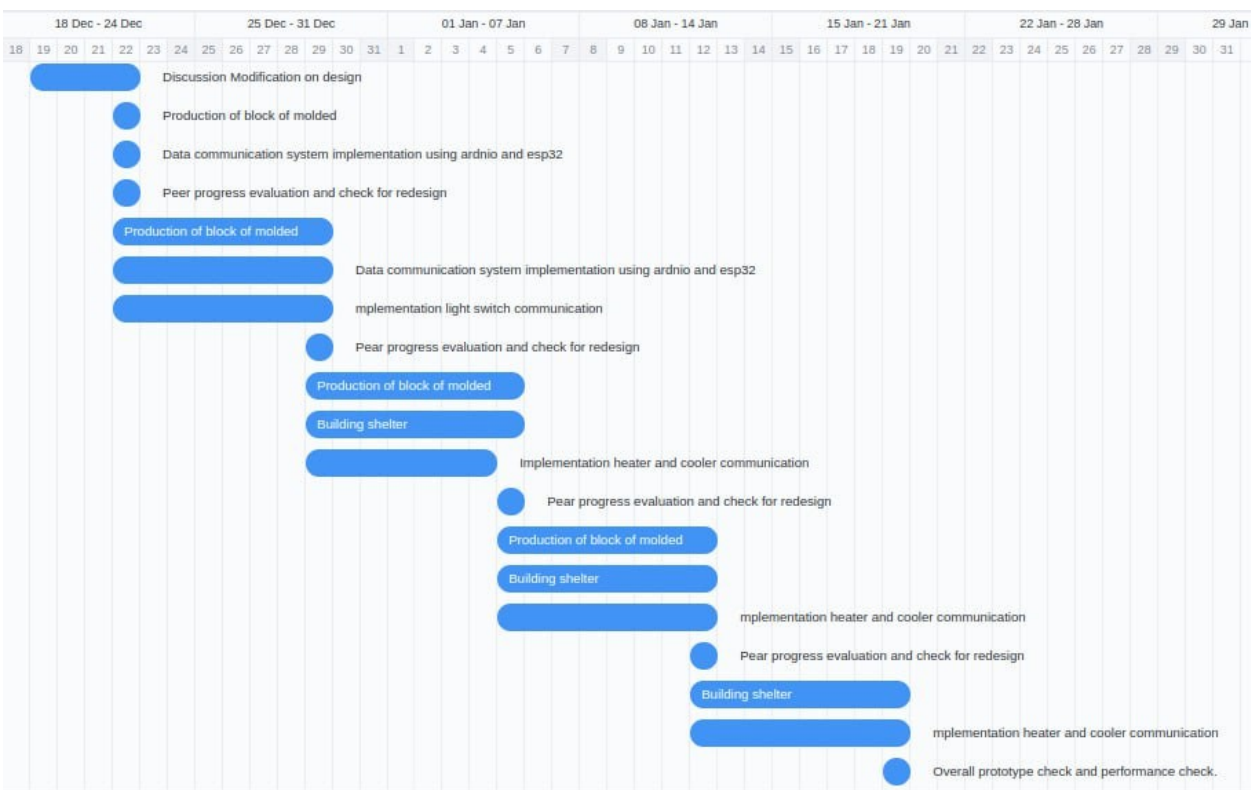
Nftalem:- As an Electrical Engineering, I am in charge of designing and implementing the project's hardware, which includes sensors and the project's functional components (lighting bulb, air conditioning, cooler, and heater). Also relevant to this field are energy sources; in this project, we will use solar panels as an energy source and batteries to store the energy captured by the panels. As per the project, studying the character of components and their selection is the main part of the discipline. Sensors, solar panels, Arduino, and other elements will be investigated and implemented by me collaborating with my team.

Besufekad:- As an Electrical Engineering, I have the duty Integrate the sensors, emergency system , air conditioning system all together. Since we will be using sensors like flame detector, sensor designed to detect and respond to the presence of a fire, emergency alarm in the temporary military camp to notify and alert fellow soldiers when there is a danger coming and we will also be using devices like an air conditioner, used for controlling the temperature in the shelter, my job will be designing the circuit and control system in order for the devices to function, collaborating with my team.

5.2 Timeline

Fabrication Process Timeline			
Week	**Activity**	**Date / Due date**	**Progress in Percentage(%)**
1	Discussion Modification on design	Monday,December 19,2022	
1	Production of block of molded	Thursday,December 22,2022	25%
1	Data communication system implementation using ardnio and esp32		75%
1	Pear progress evaluation and check for redesign	Thursday,December 22,2022	
2	Production of block of molded	Thursday,December 29,2022	50%
2	Data communication system implementation using ardnio and esp32		100%
2	Implementation light switch communication		100%
2	Pear progress evaluation and check for redesign	Thursday,December 29,2022	
3	Production of block of molded	Thursday,January 5,2023	75%
3	Building shelter		50%
3	Implementation heater and cooler communication		50%
3	Pear progress evaluation and check for redesign	Thursday,January 5,2023	
4	Production of block of molded	Thursday,January 12,2023	100%
4	Building shelter		75%
4	Implementation heater and cooler communication		75%
4	Pear progress evaluation and check for redesign	Thursday,January 12,2023	
5	Building shelter	Thursday,January 19,2023	100%
5	Implementation heater and cooler communication		100%
5	Overall prototype check and performance check.	Thursday,January 19,2023	

5.3 Project Management



5.4 Budget

Name of Component	Quantity	Price (ETB)	Total price Birr
ESP-32-WROOM-32 [Microcontroller]	1	1600	1600
Thermistor [Heat sensor]	1	200	200
Photodiode [Flame sensor]	1	100	100
12V DC Fan	1	350	350
12V DC Bulb	1	170	170
BC547	3	50	150
Resistor 2 ohm	2	20	40
Resistor 220 ohm	7	20	140
Resistor 180 ohm	1	20	20
Resistor 470 ohm	1	20	20
Resistor 1k ohm	1	20	20
Resistor 10k ohm	1	20	20
Battery (5v & 12 volt)	2	700 & 1300	2000
Charger Adapter (5v & 12v)	2	400	800
Wire Dupont Cable	2	300	600
Breadboard	1	200	200
Gray board	12	80	960
Transparent paper	10	10	100
Translucent	10	15	150
Hard paper	40	10	400
Bontex	2	80	160
UHU	4	90	360
Cutter	2	100	200
Cutter Blade	10	15	150

Scissor	2	50	100
Colour paper	10	5	50
Hot glue	3	90	270
LED lights (5v)	20	10	200
Transistors (7905)	2	100	200
Soldering led	2	30	60
Total Price			9790 Birr

Conclusion and Recommendation

The Smart Shelter project has the potential to address the critical need for safe and secure housing in emergency situations, particularly for refugees and other vulnerable populations. The project utilizes recycled plastic molds and solar power, which not only repurpose plastic waste but also reduce reliance on non-renewable energy sources. Additionally, the integration of smart technologies ensures the safety and comfort of shelter occupants.

To further develop and implement the Smart Shelter project, it is recommended that collaboration with local communities and international aid organizations be prioritized. These partnerships will ensure that the project is tailored to meet the specific needs of the communities it serves and is implemented in a culturally sensitive and sustainable manner.

It is also recommended that the project undergo rigorous testing and evaluation to ensure that it meets safety, durability, and usability standards. This will require partnerships with academic and research institutions, as well as private sector partners who can provide technical expertise and resources.

In addition to partnerships, funding and resource mobilization will be crucial for the successful implementation and scaling of the project. This can be achieved through various means, including philanthropic funding, public-private partnerships, and government funding. With proper funding and resource mobilization, the project has the potential to provide a cost-effective and sustainable solution to the housing needs of refugees and other vulnerable populations.

Finally, it is important to consider the long-term sustainability of the project. This requires addressing the environmental impact of the project, particularly in terms of the use and disposal of the plastic molds. It also requires a plan for the maintenance and repair of the shelters over time, including the replacement of any damaged or worn-out components.

In conclusion, the Smart Shelter project offers a promising solution to urgent social and environmental challenges. However, it will require strong partnerships, rigorous testing and evaluation, resource mobilization, and a plan for long-term sustainability to ensure its success.

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