Republic of the Philippines

EASTERN VISAYAS STATE UNIVERSITY

Tacloban City

WEATHER REPORTING SYSTEM FOR TWO-WAY RADIO AND FM TRANSMISSION

A Project Study

Presented to

The ECE Department

College of Engineering

In Partial Fulfilment

of the requirements for

The Subject ECE 411

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Chapter I

INTRODUCTION

BACKGROUND OF THE STUDY

The Philippines is a country that is prone to natural disasters, particularly typhoons. According to the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), an average of 15 to 20 typhoons affects the Philippine Area of Responsibility each year [1]. These typhoons can cause significant damage to infrastructure and have the potential to claim lives, particularly in areas that are prone to flooding and landslides.

One common challenge in disaster response is the reluctance of some communities to evacuate prior to a typhoon's arrival. This can be due to a variety of factors, including a lack of awareness of the potential danger or a lack of access to accurate and reliable weather information [2]. In order to effectively respond to typhoons and other natural disasters, it is crucial to have a reliable system for disseminating accurate and timely weather information to the public.

One potential solution is a weather reporting system that utilizes two-way radio and FM transmission. Transistor radios are widely used in the Philippines, particularly in rural areas where access to television may be limited. By utilizing two-way radio and FM transmission, it may be possible to reach a wider audience with weather information and potentially reduce the risk of loss of life and property due to natural disasters.

Previous research on weather reporting systems has primarily focused on the use of television and online sources to disseminate information. While these methods have proven effective in some cases, they may not be accessible to all members of the community, particularly those in rural areas. A weather reporting system that utilizes two-way radio and FM transmission has the

potential to reach a wider audience and improve the effectiveness of disaster response efforts in the Philippines.

This research aims to develop and evaluate a weather reporting system for two-way radio and FM transmission in the Philippines. By addressing the gap in the existing research on weather reporting systems and exploring the potential benefits of a system that utilizes two-way radio and FM transmission, this study aims to contribute to the improvement of disaster response efforts in the Philippines and potentially reduce the risk of loss of life and property due to natural disasters.

OBJECTIVES OF THE STUDY

This study aims to provide a prototype of the "Weather Reporting System for Two-Way Radio and FM Transmission" that will keep the townspeople updated using a commonly used transistor radio, and/or two-way radio for the amateur radio enthusiasts, which will transmit relevant weather information in the locality.

Specifically, it aims to present the following:

1. To establish a model of a functioning and understandable Text to speech module (TTS) with data from the state bureau's online RSS weather feed.
2. To be able to inform the public of the current weather situation, such as temperature, humidity, and precipitation, in a thirty-minute interval through the FM transmission or on-demand through the DTMF inputs coming from a two-way radio.
3. To utilize the radio spectrum specifically in the Very High Frequency (VHF) and Frequency Modulation (FM).
4. To construct a working prototype of the Weather Reporting System and to determine its functionality as a device.

SCOPE OF THE STUDY

1. The Weather reporting system is focused on helping Tacloban City in referring to accurate weather data from the state weather bureau without the need for expensive methodologies in obtaining information such as data plans from mobile carriers and therefore delegating the superiority and reliability of both the FM transmission and two-way radio transmission.

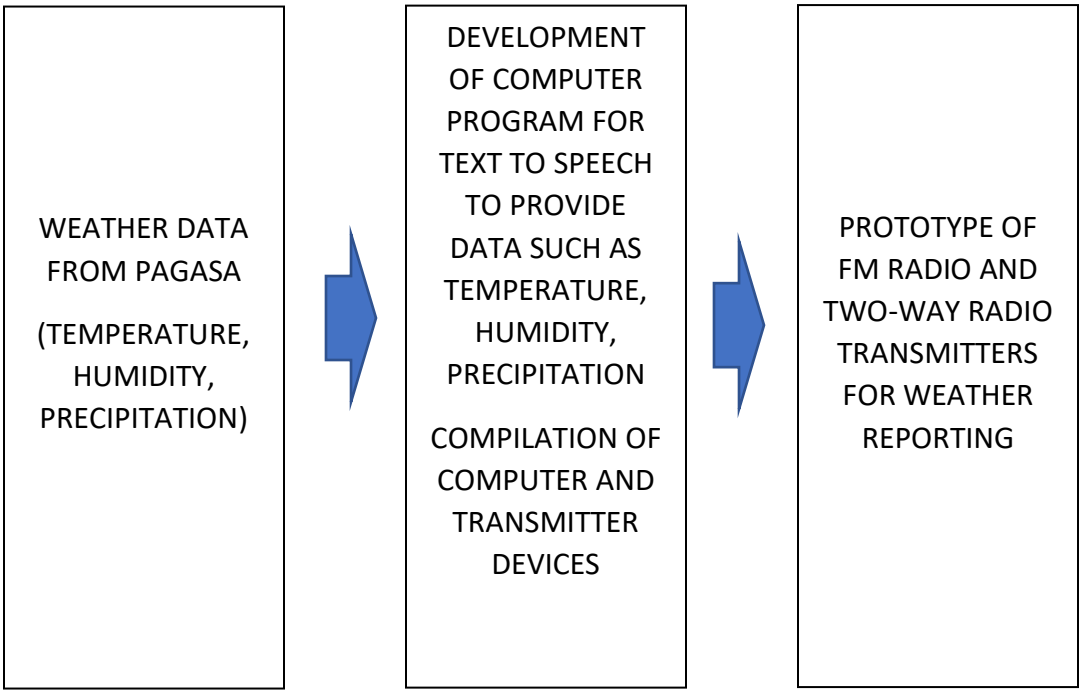
DELIMITATION OF THE STUDY

Since the project design is intended as a prototype only, the following limitations are considered:

1. Weather reporting from neighbouring towns is not included.
2. The Text to speech program may encounter errors when the RSS feed or GUI may be subjected to cosmetic or back-end changes.
3. Weather reports come directly from the state weather bureau, through the internet, therefore cannot be wholly accurate from the real weather situation in the locality as the bureau has a limited number of doppler radars clustered for different localities.
4. There is no actual measuring equipment present in the prototype and is only reliant to internet data.
5. The project, being reliant on the internet, may experience downtime if ever the internet service provider (ISP) is under maintenance or is experiencing a network problem.
6. The project, using a low-powered FM transmitter, may be subject to regulations from the National Telecommunications Commission (NTC) regarding its transmission specifications.

7. The project, also utilizing a two-way radio, may also be subject to restrictions from the National Telecommunications Commission regarding its use case, allowed frequencies, and output power.

CONCEPTUAL FRAMEWORK



SIGNIFICANCE OF THE STUDY

The project researchers believe that the following will be benefitted from the result and success of this study.

People of Tacloban. As a locality with high prevalence of storms occurring in a span of a year, this will benefit them in recognizing the importance of preparedness especially if lives are at stake. With the device being introduced in the consciousness of the common folk, then we can encourage discipline when it comes to preparing such as evacuating early when there is an impending storm

Local Government Units. LGU's can opt to deploy such systems in their respective areas of responsibility so that they can easily disseminate further typhoon warnings especially in far-flung areas and hazard prone areas that might be accessible hours or days before the onslaught of a storm.

The National Government. The government can acquire a stable edition of this prototype to be part of the basic National Disaster Risk Reduction program as these can be a steppingstone in utilizing a somewhat niche resource of the government that is the Radio spectrum, providing for a low-cost and reliable device that can be deployed either on fixed or mobile configurations, as deemed necessary in the situation beforehand.

Future Researchers. The result of this project research will empower future research proponents to conduct similar research in their respective localities and to improve upon the system with respect to the need of the end user especially if it prefers an actual measuring device to be present in the system. The result of this project can also be a steppingstone in recommending this to the Department of Science and Technology, most especially the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), to deploy similar systems with better equipment in typhoon-prone areas to address the gap in disseminating timely and accurate information regarding the indicated weather phenomenon. This design will be an appropriate tool for future researchers to further their knowledge and skills and provide valid modifications and improvements to this prototype. This will encourage them to design a similar project to benefit their respective local government units, especially in hazard prone areas. This will also further interest geeks specializing in programming, antenna design, and transmission, to conduct a related study.

DEFINITION OF TERMS

The important terms or concepts of the study are defined, for better understanding of the readers about this research project. The terms are defined based on what function they provide for the research project.

Weather - The weather is the information being used coming from the various instruments dedicated to measuring the behaviour of the environment within the locality. It is the basis used in determining the current situation in a locality.

Weather Reporting System – The Weather Reporting System is the key function of the project prototype. It is a program that utilizes text-to-speech to convert the current weather report for a selected place into an understandable information that is to be transmitted by both the FM transmitter and the Two-way radio device. This project study is different from the previous weather monitoring devices as it relies on the data provided by PAGASA through the internet.

FM Transmitter – An FM Transmitter is an electronic device which outputs radio signals with an antenna. It is the key component of the project for the relay of weather data for public consumption using their respective FM Receivers.

Two-way Radio – A two-way radio is an electronic device that has the function to both receive and transmit data, in this case, audio, at a given moment. Commonly known as a “transceiver”, it is commonly used by radio groups, as well as other government agencies, in relaying vital information in their line of work easily. In this project, it will serve also as a transmitter and will also receive remote control parameters through DTMF.

Raspberry Pi – The Raspberry Pi is a minicomputer capable of running programs meant for complex usage. It serves as a gateway for people to explore programming and is an open design

computer meaning it can be served for other purposes. In this study, it will be the main data and audio generator and the RF modules will be hooked up in this device.

DTMF Decoder - A DTMF Decoder, in this case, a model MT8870, is a complete dual tone multi-frequency receiver with an integrated band split filter and digital decoder functionality. It utilizes digital counting techniques to detect and decode all sixteen DTMF tone-pairs into a four-bit code. In this project, this will serve as the translator of remote instructions transmitted by a two-way radio using its keypad, to attain a certain functionality present in the project.

RSS – commonly known as Really Simple Syndication, it is a web feed that allows applications or websites to access updates from other websites in a standardized format that is readily understood for the user. The information from the RSS feed will serves as data for the project to be distributed.

TTS – Text to Speech, or formally known as Speech synthesis, is the artificial production of human speech using a computer or a device. It analyses text to be converted into a readily understood medium, such as audio. The text data from the RSS feed or website will then be fed to the generated TTS program to be then collected as an audio file and be transmitted.

Chapter II

REVIEW OF RELATED LITERATURE AND STUDIES

This chapter includes information from articles, books, and the internet which are relevant to the present project study.

RELATED LITERATURES

Communication Breakdown

The United Nations defines a disaster as “a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources”[3]. A breakdown in communication during a disaster paralyzes civilization since it is crucial for society to function. When a tragedy strikes, people urgently need information to help them understand their condition and to connect with other community members, like their friends and families. As a result, it has been suggested that informational support is just as crucial as material support (e.g. relief, food, and shelter).

Interviews with Puerto Ricans who had been impacted by Hurricane Georges in 1998 revealed that the media also serve as companions, providers of emotional support, and avenues for social interaction. [4]. Because of electric supply interruptions, battery-operated radio became the only available option for information and, in the process, took on a role beyond the passive transmission of information [4]. As survivors called radio stations to inform others about their conditions, "people from other towns responded to those phone calls, phoning back to get additional information or to supplement what had been stated," establishing an interactive media-audience interaction. [4].

In a press interview with OCHA months after the typhoon Haiyan in Tacloban, City “The extent of the devastation brought by Haiyan not only disrupted communities’ access to critical life-saving information in the first few days after the Typhoon; it also affected life-sustaining information due to limited communication channels months afterwards.” [5].

In 2013, April Mercado, a United Methodist communication specialist who manage to deliver communication out from Tacloban through a ham radio. “The first communication that came out from Tacloban after typhoon Haiyan was from a ham radio.” [6]. “All cellphone communications were, you know, down. I had difficulty contacting my family to tell them I’m okay.” [6]. The experience during typhoon Haiyan helped to realize how amateur radio can be a lifeline in a country that typhoons, earthquakes, and volcanic activity.

Two Way Radio

Two-way radio is often referred as “professional mobile radio”, “private mobile radio” (PMR), or “land mobile radio” (LMR), and colloquially referred to as walkie-talkies. Two-way radios most often use the Very High Frequency (VHF) and Ultra High Frequency (UHF) bands. Portable two-way radios have a communication distance of a few kilometers when directly transceiving to/from each other but when they make use of radio repeaters or Radio over IP (RoIP) the distance is almost unlimited. Radio technologies are also used in Public Protection and Disaster Relief (PPDR) emergency response systems [7]. Despite the existence of communication options including cellphones, smartphones, phone lines, leased lines, and the Internet, the infrastructure required for these options can occasionally undergo blackouts. Certain components of a country's infrastructure are frequently regarded as vital because a breakdown or disruption could have detrimental effects [8]. As a result, mission-critical companies utilize two-way radio to maintain communication in the event of infrastructure problems [9].

In rural areas, where electricity and communication infrastructure may be limited, two-way radios can help people stay connected and coordinate their actions during emergencies or other situations that require communication. They are relatively affordable, easy to use, and can operate independently of centralized infrastructure, making them a practical choice for rural communities.

The situation described in the third-class municipality of Bangar, La Union Province highlights the importance of having alternative communication methods in place in rural areas, especially during disasters. In this case, the village becomes separated by water from the mainland in the event of flooding, causing them to lose electrical power and communication infrastructure.

Using two-way radios to relay messages through people living in the other area can be an effective way to maintain communication and coordinate response efforts during the disaster [10]. This method of communication can help to bridge the gap between the separated areas and ensure that critical information and instructions are being exchanged.

FM Transmission

Information seeking before and during disasters is a complex multi-process behaviour [11] [12] [13] [14] [15] [16] [17]. To connect impacted individuals, families, and communities with first responders, support networks, and other family members, communication is crucial during and shortly after a disaster crisis. A community's resilience depends on effective communication and information systems that are both accessible and dependable. Typically, the electrical source is damaged while commercial radio and other forms of communication are cut off. Consequently, the place could potentially end up being isolated. Due to its ability to transmit data over long distances without the use of a repeater and because it is more reliable during a disaster, FM radio communication was chosen to transmit data from the master station at the data center in the local

disaster relief agency to the workstation of the electronic information board in the remote areas [18].

Local Weather Reporting

The first target in the sustainable development goal (SDG) 13 of combatting climate change and its impacts is strengthening resilience and adaptive capacity to climate related hazards and natural disasters [19]. Maintaining community, household livelihood, and individual resilience is crucial due to the Philippines' propensity for weather and climate-related risks, disasters, and crises. Local knowledge plays a crucial role in planning to boost and maintain community resilience, particularly in communities of indigenous people. Traditional and indigenous knowledge from the area might be a valuable resource for local response tactics [20]. As a method of survival, these skills are frequently ingrained in a community's way of life [21]. Determining methods to maintain and boost resilience therefore requires an awareness of the local knowledge regarding weather disturbances and climate variability in a community.

For farmers in Mindanao, locally generated meteorological data and site-specific forecasts are essential for organizing their planting schedules and safeguarding farm equipment and livestock. Those agricultural techniques that are supported by early warning data, technologies, and tools were referred to as risk-informed practices. Automated Weather Stations (AWS) have been installed by the program and NGO partners by actively involving the Municipal Agriculture Office in the execution of the Climate-resiliency Field Schools (CrFS). Alamada, Jabonga, Pigcawayan, Esperanza, and Bagumbayan stations (AWS) at local government offices [22]. Weather predictions and bulletins of advice were provided farmers with timely information on local weather, farming activity, and disaster readiness through daily broadcasts on local radio stations, cable, and satellite television. Farmers recorded their own weather observations (daily) in

seasonal calendars and integrated them with LCIC. projections, regional customs, national holidays, labor demands, and indigenous wisdom.

PAGASA

PAGASA, one of the Department of Science and Technology's (DOST) attached agencies, is charged with "providing protection against natural calamities and using scientific knowledge as an effective tool to ensure the safety, well-being, and economic security of all people, as well as for the promotion of national progress." [23]. It issued information on tropical cyclone even before it enters the Philippine Area of Responsibility (PAR). There are 52 stations total, spread out across the nation. Of these 52, 16 are in climatic types 1 and 1, 16 are in types 2 and 3, 12 are in types 3, and the final 8 are in types 4 and 5. Ten stations in climatic type one is situated in coastal regions, and the remaining stations are spread out inland. All climate type 2 stations are situated near coastlines. Ten coastal stations and two inland stations make up the stations with a climatic type 3 classification. Regarding climatic type 4, the stations are equally split between inland and coastal regions [24].

Radio Spectrum Frequency

In order for wireless communication systems to function effectively, the radio frequency spectrum must be used efficiently since it is a limited natural resource [25]. Numerous wireless services and applications, including data-focused smart phones, Bluetooth gadgets, broadband Wi-Fi internet connections, satellite radios, and GPS navigation systems, have evolved in recent years from esoteric luxuries for the affluent to commonplace items used by the general public. As a result, the radio spectrum allocation is almost being saturated [26]. One such approach is Dynamic Spectrum Sharing (DSS), which involves the opportunistic use of unused spectrum by secondary users while ensuring that primary users are not affected. The study of the availability of spectrum

between television signals presents an opportunity for DSS since broadcast television services offer wide coverage and high building penetration. The study by Van de Beek et al. on TV White Space in Europe investigates the availability of spectrum after the digital switch-over from analog to digital transmission. The study examines the occupancy of the VHF and UHF bands and identifies parts of the spectrum with low occupancy. The study also describes the measurement systems used, data calibration, and system occupancy results.

RELATED STUDIES

Feasibility of an Amateur Radio Transmitter Implementation Using Raspberry Pi for a Low Cost and Portable Emergency Communications Device

The study was conducted by C.P Quitevis and C.D Ambatali from Electrical and Electronics Engineering Institute University of the Philippines Quezon City, Philippines. In which they proposed a low-cost and portable implementation of an amateur radio module based on Raspberry Pi (RPi) that can convert a message from a smartphone sent through Wi-Fi to an Automatic Packet Reporting System (APRS) broadcast that can be recognized by amateur radio equipment. They merged the ROGER project's idea of converting Wi-Fi to a different communication protocol with the RPi board's ability to transmit FM signals via its GPCLK. Amateur radio operators frequently communicate using FM signals, and they also use the Automatic Packet Reporting System (APRS) to provide GPS and brief text messages. Amateur digipeaters and amateur satellites are two ways that APRS beacons can be transmitted to the APRS iGate, an Internet gateway for APRS beacons. This system can send several data types and is simple to use. The system is simple to connect to with any Wi-Fi capable device. The RPi board transforms into a server that can be visited via a browser, and the user's message is then internally transformed by the RPi into a Bell 202 audio signal and broadcast using the GPCLK. Any adjacent APRS-enabled device will then be able to receive the APRS beacon, which can subsequently be disseminated to the relevant authorities [27].

IoT BASED DIGITAL SIGNAGE BOARD USING RASPBERRY PI 3

This study aims to develop a digital signage system that can display advertisements and real-time data such as live traffic details, weather updates, and news, while also being remotely controllable. The system is built around a Raspberry Pi 3, which acts as the central component, and a Node.js web server to host the front-end and back-end web interface. The digital display is connected to the Raspberry Pi via HDMI, and no additional hardware is required. Real-time data is extracted from the internet using data scraping techniques and the system makes http calls to APIs, which return the required data in .json format. The system allows for uploading and deleting advertisements via a control panel that is accessed by entering a username and password. Users can control the number of advertisements displayed, the time to display an advertisement, the time to display real-time traffic, and the location of live traffic details. Images uploaded or deleted from the control panel will have an immediate effect on the advertisement slide show without the need for refreshing, which is achieved using the concept of threading in Node.js. This study was significant to ours since we used the Raspberry Pi as our primary data processing device. The Raspberry Pi turns weather data into a text-to-speech format, or audio file, using a predefined RSS feed or website [28].

Chapter III

METHODOLOGY

SYSTEM OVERVIEW

The Raspberry Pi 4 Model B is a minicomputer that will be the main component of the system. The FM Transmitter and Two-way radio will be connected to it and will be dependent on its output.

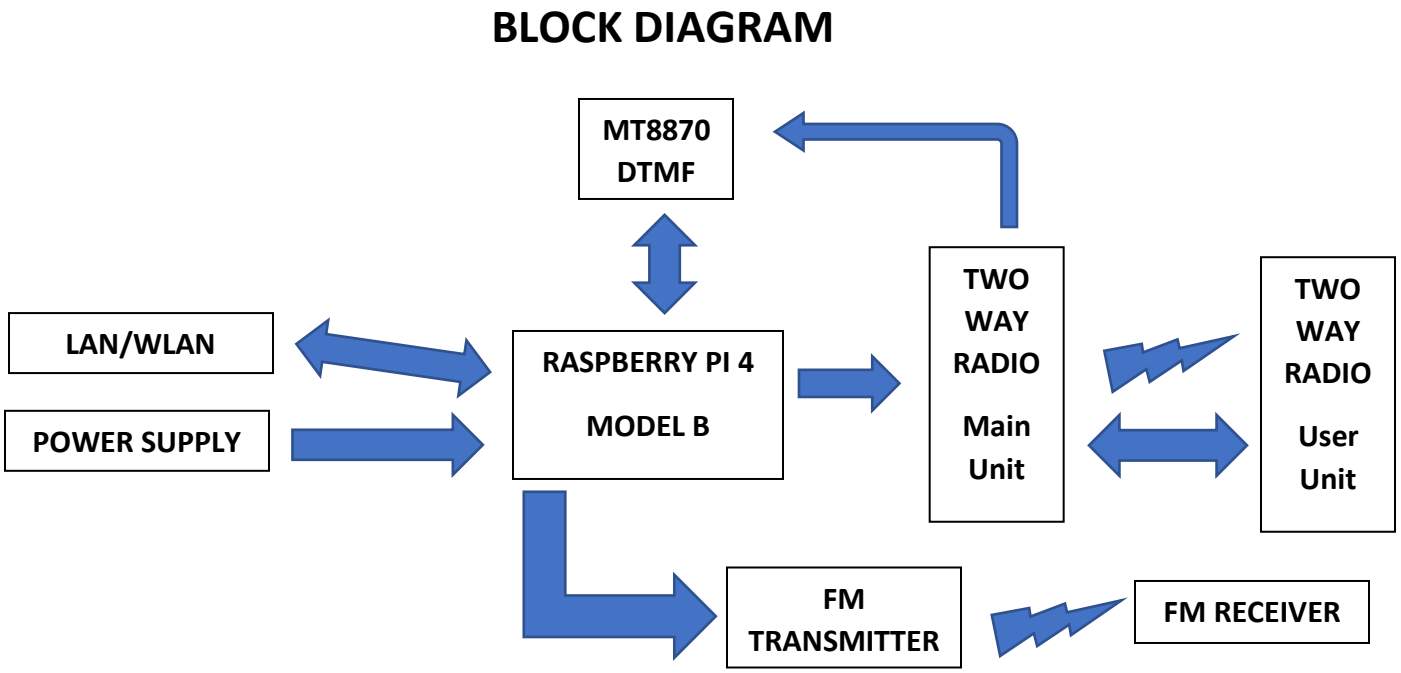


Figure 3.1

Figure 3.1 shows the wiring block diagram of the project study. The Raspberry Pi is the main data processing module, which collects weather information from a set RSS feed or Website and converts it into a text to speech format, in a form of an audio file. The processed data will be then sent to the FM Transmitter and the main Two-way radio unit to be transmitted for FM and VHF, respectively. The MT8870 DTMF module will serve as the decoder for the keypad input signals of the two-way radio communications. This will be powered by the Raspberry Pi's GPIO

pins. The Raspberry Pi will be powered by a 5V/3A power supply, while the FM transmitter will be supplied by a 5V power supply, and the two-way radio's battery will be circumvented with a makeshift battery eliminator that can supply a constant a nominal 7.5-8V to the radio.

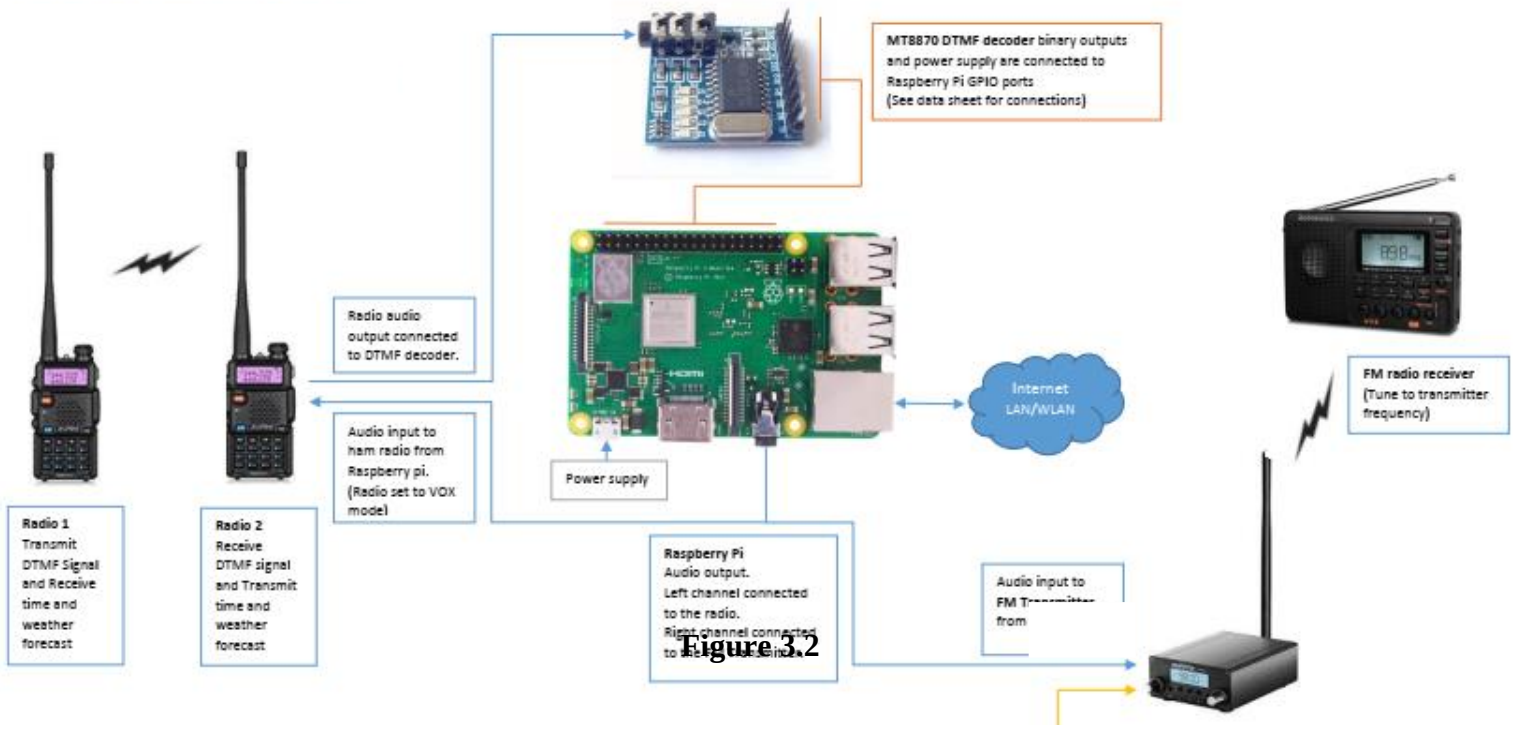


Figure 3.2

Figure 3.2 shows the specific function of each component in the device. The main function of the device is to transmit weather data through the FM Transmitter and two-way radio every thirty minutes, or on demand through the DTMF inputs for the two-way radio keypad.

RESEARCH INSTRUMENT

By aiming for the project to become a reality, the following instruments are used in the said project. A mix of hardware and software play an important role in making the Weather Reporting System. For the Hardware, it utilizes the Raspberry Pi, MT8870 DTMF Decoder, PLL FM Transmitter and a Baofeng/Platinum UV-5R VHF Transciever. While for the software, Raspberry Pi OS and Python are used to store the program and execute the program, respectively.

HARDWARE

- **Raspberry Pi 4 Model B**

Figure 3.3

Figure 3.3 is the Raspberry Pi 4 Model B, it is equipped with a 1.5 GHz 64-bit quad core ARM Cortex-A72 processor, on-board 802.11ac Wi-Fi, Bluetooth 5, full gigabit Ethernet, two USB 2.0 ports, two USB 3.0 ports, and 8 GB of RAM. It contains the program needed for the device to be implemented. It is standalone and therefore can be ran independently in between sessions without the need of initialization.

- **MT8870 DTMF Decoder**

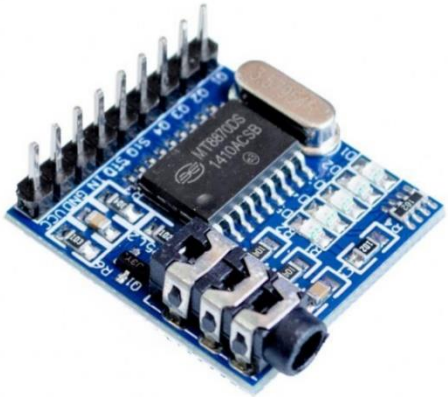


Figure 3.4

Figure 3.4 is the MT8870 DTMF Decoder, it is a tone decoder that detects dual sine wave tones from keypad presses. With the module connectors utilized, a binary signal will be processed from incoming keypad signals and therefore will be responsible for the relay of instruction to the main computer module on what data to transmit.

- **PLL FM Transmitter**

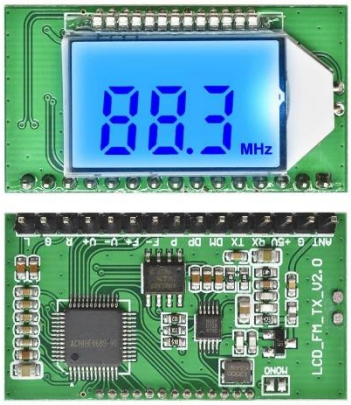


Figure 3.5

Figure 3.5 is a PLL FM Transmitter. It has the functions of providing a stable, low noise, frequency-selectable RF signal and amplify it to a controllable output power sufficient to drive the power amplifier. This device will cover the transmission work on one of the two modes of transmission of the device, mainly the FM Band Transmission.

- **Baofeng/Platinum UV-5R Transceiver**

Figure 3.6

Figure 3.6 is a Baofeng/Platinum UV-5R Handheld Transceiver, it is a Dual band VHF/UHF two-way radio capable of outputting a maximum power of 5 watts. It also has a keypad and a speaker output and microphone input which will be utilized for connection to the DTMF Decoder and Raspberry Pi audio out, respectively.

SOFTWARE

- **Raspberry Pi OS**

Figure 3.7

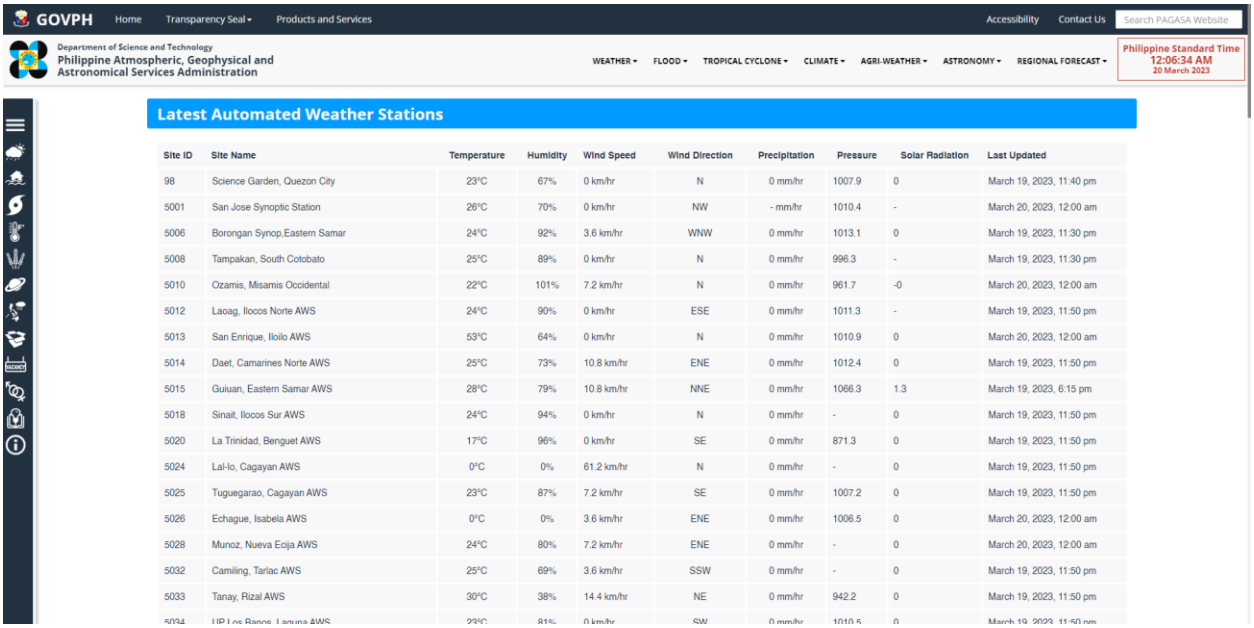
Figure 3.7 is the Raspberry Pi OS, formerly called Raspbian, is a Unix-based operating system specifically designed for single board computers like the Raspberry Pi. In this project, it will therefore be the carrier of the program to be executed for it to work seamlessly.

- **Python**

Figure 3.8

Figure 3.8 is Python, it is a computer programming language with a broad collection of libraries and suppositories, making it the go-to programming language for beginners. In this project, it will serve as the program's springboard as all codes will be written in this language and will also execute the program which will then be essential for the project to work.

- **PAGASA Latest Automated Weather Stations Website**



Site ID	Site Name	Temperature	Humidity	Wind Speed	Wind Direction	Precipitation	Pressure	Solar Radiation	Last Updated
98	Science Garden, Quezon City	23°C	67%	0 km/hr	N	0 mm/hr	1007.9	0	March 19, 2023, 11:40 pm
5001	San Jose Synoptic Station	26°C	70%	0 km/hr	NW	- mm/hr	1010.4	-	March 20, 2023, 12:00 am
5006	Borongan Synop,Eastern Samar	24°C	92%	3.6 km/hr	WNW	0 mm/hr	1013.1	0	March 19, 2023, 11:30 pm
5008	Tampakan, South Cotobato	25°C	89%	0 km/hr	N	0 mm/hr	996.3	-	March 19, 2023, 11:30 pm
5010	Ozamis, Misamis Occidental	22°C	101%	7.2 km/hr	N	0 mm/hr	961.7	-0	March 20, 2023, 12:00 am
5012	Laoag, Ilocos Norte AWS	24°C	90%	0 km/hr	ESE	0 mm/hr	1011.3	-	March 19, 2023, 11:50 pm
5013	San Enrique, Iloilo AWS	53°C	64%	0 km/hr	N	0 mm/hr	1010.9	0	March 20, 2023, 12:00 am
5014	Daet, Camarines Norte AWS	25°C	73%	10.8 km/hr	ENE	0 mm/hr	1012.4	0	March 19, 2023, 11:50 pm
5015	Guiuan, Eastern Samar AWS	28°C	79%	10.8 km/hr	NNE	0 mm/hr	1066.3	1.3	March 19, 2023, 6:15 pm
5018	Sinait, Ilocos Sur AWS	24°C	94%	0 km/hr	N	0 mm/hr	-	0	March 19, 2023, 11:50 pm
5020	La Trinidad, Benguet AWS	17°C	96%	0 km/hr	SE	0 mm/hr	871.3	0	March 19, 2023, 11:50 pm
5024	Lal-lo, Cagayan AWS	0°C	0%	61.2 km/hr	N	0 mm/hr	-	0	March 19, 2023, 11:50 pm
5025	Tuguegarao, Cagayan AWS	23°C	87%	7.2 km/hr	SE	0 mm/hr	1007.2	0	March 19, 2023, 11:50 pm
5026	Echague, Isabela AWS	0°C	0%	3.6 km/hr	ENE	0 mm/hr	1006.5	0	March 20, 2023, 12:00 am
5028	Munoz, Nueva Ecija AWS	24°C	80%	7.2 km/hr	ENE	0 mm/hr	-	0	March 20, 2023, 12:00 am
5032	Camiling, Tarlac AWS	25°C	69%	3.6 km/hr	SSW	0 mm/hr	-	0	March 19, 2023, 11:50 pm
5033	Tanay, Rizal AWS	30°C	38%	14.4 km/hr	NE	0 mm/hr	942.2	0	March 19, 2023, 11:50 pm
5034	UP Los Banos, Laguna AWS	23°C	81%	0 km/hr	SW	0 mm/hr	1010.5	0	March 19, 2023, 11:50 pm

Figure 3.9

Figure 3.9 is the PAGASA Latest Automated Weather Stations Website, it is the official website of the state weather bureau's official list of deployed and active Synoptic and Automated Weather Stations. In this project, it will serve as the data source for the project relies solely on internet data in the absence of an actual measuring device.

CIRCUIT DIAGRAM

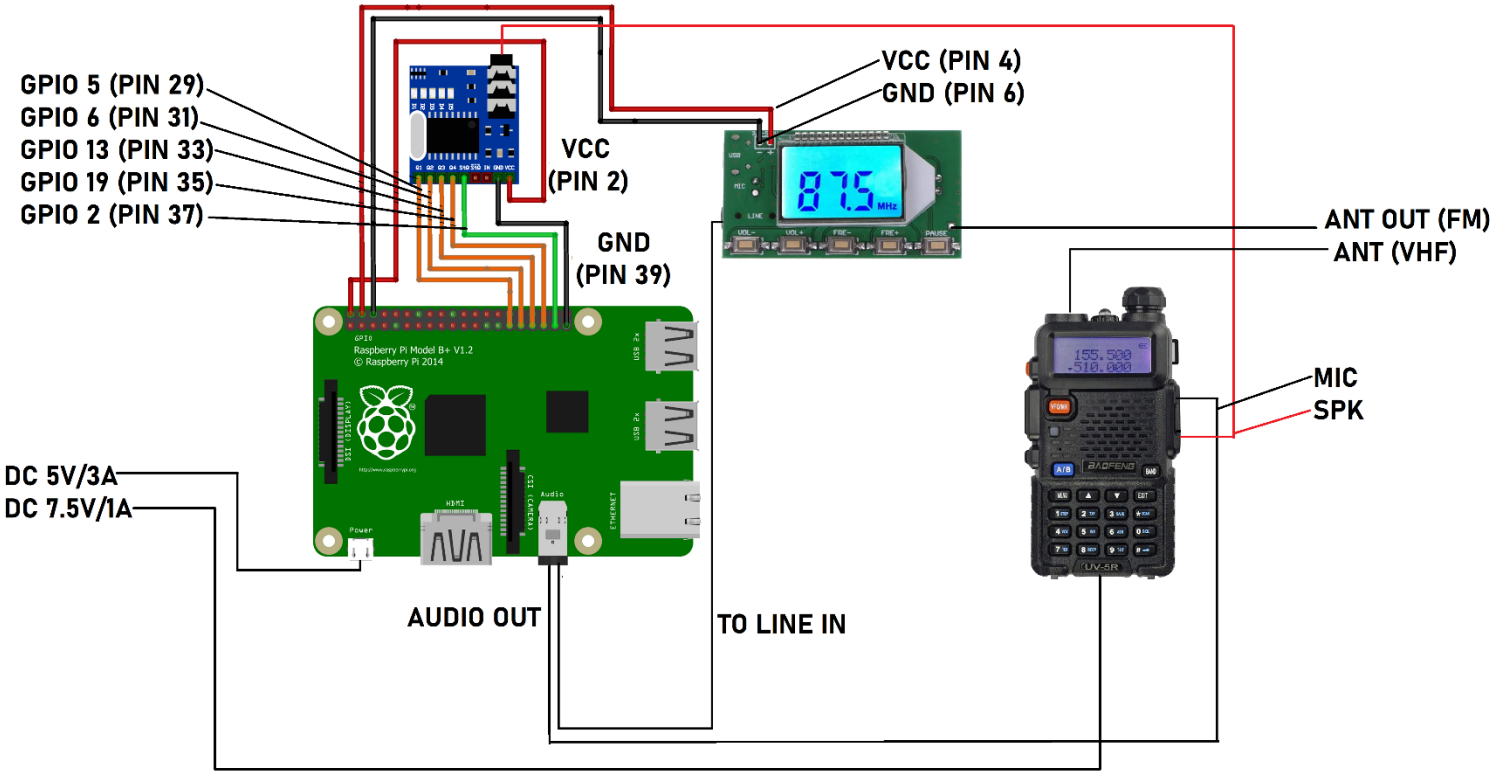


Figure 3.10

Figure 3.10 is the circuit design; the detailed schematic of the device is depicted. The GPIO pins of the Raspberry Pi, namely GPIO 5,6,13,19, are allocated for the Q1, Q2, Q3, Q4 pins of the MT8870 DTMF Decoder. While the Audio out of the Raspberry Pi will be split into the Two-way radio and FM Transmitter.

SYSTEM FLOW CHART

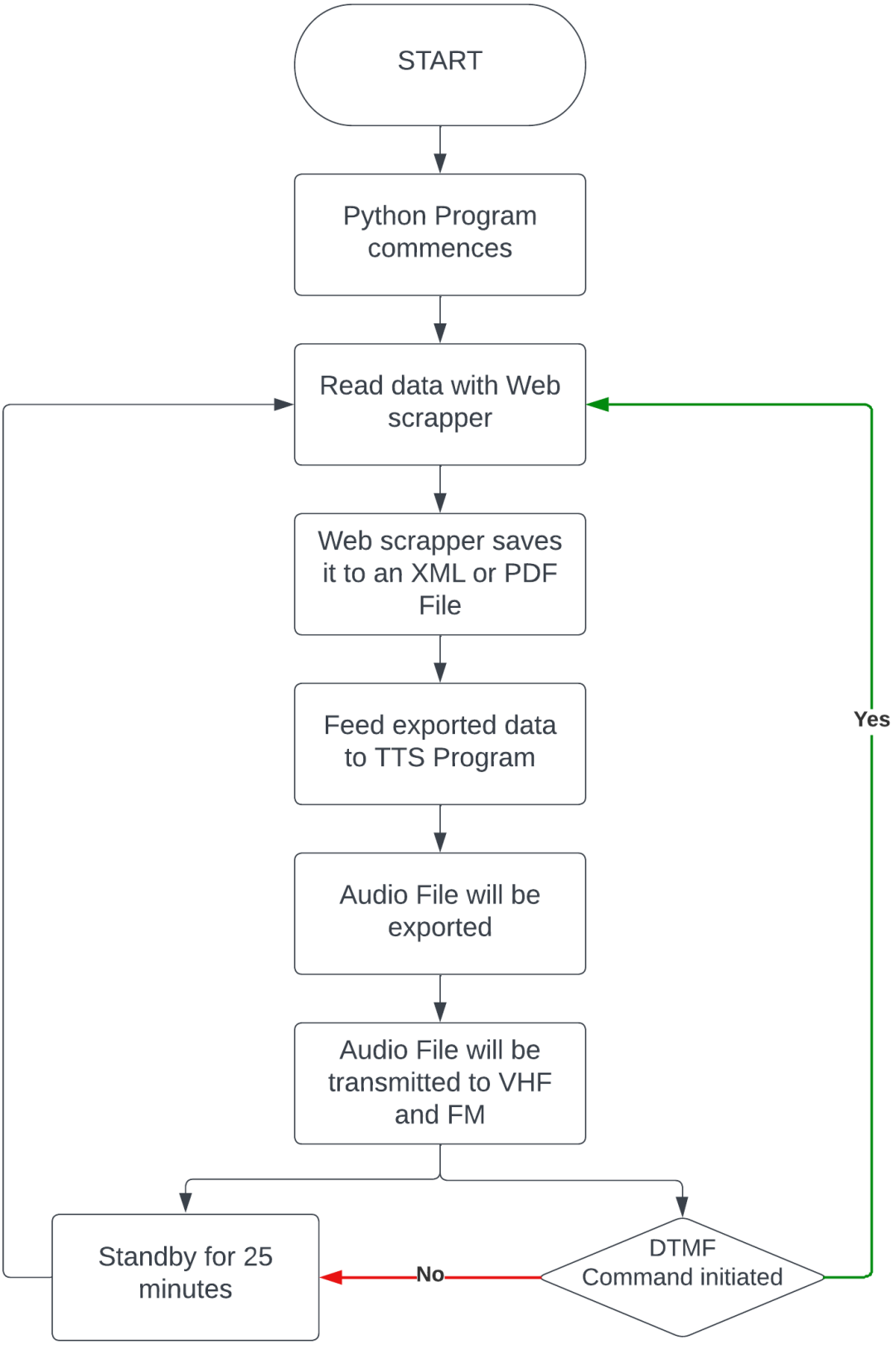


Figure 3.11

Figure 3.11 is the System flow chart. The device is meant to be operated seamlessly and with minimal initialization after every cycle, it can be also controlled remotely through the two-way radio as the DTMF decoder is installed for this purpose. The resulting audio from the conversion of text to speech will be transmitted every thirty minutes or on-demand with a set DTMF Function coming from the two-way radio.

PRODUCT DEVELOPMENT

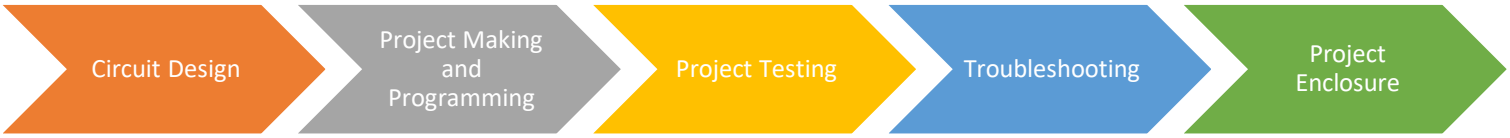


Figure 3.12

Figure 3.12 shows the steps of product development for the project. The researchers first identified the appropriate circuit design and acquired the necessary equipment and components required for the project. Then an initial testing is done as well as the crafting of the program to ensure the workability of the project. It therefore is troubleshooted to ensure that major setbacks are avoided. Lastly, an appropriate project enclosure is made for the device to be presentable.

TESTING PROCEDURES

The researchers will implement the following testing procedures.

- **Functionality Test**

  To ensure the device will work, it therefore is essential to test the following: (1) internet connectivity if it is connected to the internet. (2) FM Transmitter and Two-way radio if both devices are ready to transmit audio data.

- **Accuracy Test**

  The Python program will be tested if it has accurately scrapped the intended data such as temperature, humidity and precipitation, and if it can also cycle the program in a thirty-minute interval.

- **DTMF Decode Test**

  A DTMF Decode test will be done to ensure that proper instructions from a set combinations from a keypad will therefore translate to the intended function for the end user.

- **TTS Test**

  The Text to speech module will be tested for its accuracy, in the context of whether it will be intelligible to the end user, and also if it can accurately provide audio data.

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