IOT-BASED LIFE MONITORING FOR HUMAN WITH SPECIAL TREATMENT NEEDS

FINAL PROJECT PROPOSAL

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CHAPTER 1

INTRODUCTION

1. RESEARCH BACKGROUND

Tripping at staircases and restrooms, choking, physical and mental diseases from psychological issues, and sudden organ failure might end up in death regardless of human aging, which inadvertence in nursing mainly becomes the main issue of human monitoring. Risks aggravate when a human with special treatment needs (e.g., children, elderly human, human with mental disease) is left alone when no other family member is inspecting at the moment. However, humans in special treatment needs might never be able to be inspected by leaving one of their family members around.

Proposed research is to develop an IoT-based human life inspector by combining several sensors to be attached to a sample of humans. Data gained will be stored in the cloud and used as feedback to the system whether the condition of the inspected is safe or otherwise. Records are also possible to be viewed at the smartphones of the inspector and the inspected for medical uses

2. LIST OF PROBLEMS

List of problems of this research is described as follows:

- What are the parameters involved to track biological, psychological, social, and digital state of a human with special treatment needs?
- What sensors are able to be put to use to assemble an IoT life inspector?
- How to assemble an IoT life inspector by software and hardware?
- How is the significance of the contribution made by the IoT life inspector for monitoring the life of humans with special treatment needs?

3. RESEARCH LIMITATION

Limitations of this research is described as follows:

- Sensors are chosen by the consideration of research budget
- Signals taken are prone to noise.
- Device assembly purpose is limited for prototyping

4. RESEARCH GOALS

This research will be done by assembling an IoT life inspector device. By storing data obtained from sensors to the cloud, users are able to get records of activity review once at weekends. IoT life inspector device is also assembled for the purpose of human life tracking in aspects of bio-marking, psycho-marking, socio-marking, and digital marking. Main purpose of the IoT life inspector device is to prevent humans with special treatment needs from being uninspected when exposed to any sudden lethal harm.

CHAPTER 2

LITERATURE STUDIES

1. Main Issue

A lot of causes end up in human death. According to Our World in Data (https://ourworldindata.org/causes-of-death), around 56 million people die each year from various ages and causes. Causes of death come mostly from cardiovascular diseases with a number of 18.56 million people in 2019. However, another common cause of death comes from either communicable or non-communicable diseases (NCD), conflicts, maternal or neonatal diseases, and injuries. The data comes from various ages of 56.5 million human died in 2017 when most people survive their times of younger age (5-14 years old with the frequency of 1%) and most deaths occur at the age of 70+ years old with the frequency of 51% and 50-69 years old with the frequency of 26%. Since 2019, the well-known coronavirus disease has killed 6,932,591 people (https://covid19.who.int/?mapFilter=cas) in which coronavirus disease is considered to be one of respiratory diseases.

By looking at the data gathered, humans with physical and mental disease in various ages might be considered as humans with special treatment needs. Physically and mentally deteriorated elderly humans, humans with depression and mental disorders, babies with neonatal diseases, and conflicting humans also need additional attention to keep them safe. Therefore, parameters for IoT life inspector involve combinations of heart beat rate, oxygen saturation in blood, body temperature, movement, and location.

2. Past Researches

From previous literature studies, Laila, Haque, and Ali (2019) developed smart patient rooms based on the Internet of Things. In that research, a room is set to monitor body temperature, heart beat rate, and patient details review. Comparison from this proposed research is that the device assembled is able to monitor humans anywhere and everywhere as long as the device is linked with the internet. Some parameters including blood oxygen saturation, body movement, location, and digital activity history are also added in this proposed research which turns the product into jack-of-all-trades for human life tracking devices.

3. Components and Mechanisms

IoT life inspector uses MAX30100 as pulse oximeter and heart rate sensor, MPU-6050 as accelerometer combined with gyroscope to measure movement, and DS18b20 as temperature sensor. All these sensors are connected to the powered ESP32 with note that ESP32 is not able to endure the voltage of 5V from the sensors. To resolve this problem, a logic converter is used to convert the input voltage of ESP32 to 3.3V which the assembly diagram is shown at Fig. 1.

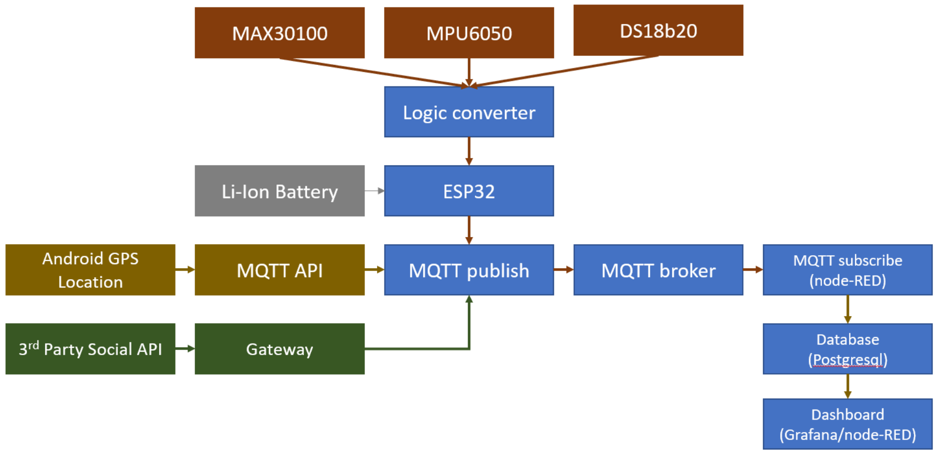

Fig 1. Assembling Diagram of IoT Life Inspector

ESP32 receives all data from every sensor and communicates by publishing data to the MQTT publisher. MQTT broker will be the middleware between MQTT publisher and MQTT subscriber. By accessing the dashboard using a smartphone, outputs are able to be controlled.

MAX30100 is an integrated pulse oximetry and heart beat sensor (from Maxim Integrated datasheet, 2014). This sensor is known for its simple design by integrating two parameters, extremely low power consumption, and advanced functionality which increases measurement performances.

MPU-6050 is one of MPU-60X0 family which is a 6-axis motion tracker sensor consisting of 3-axis accelerometer, 3-axis gyroscope, and a digital motion processor (from InvenSense datasheet, 2012). Its I^2C sensor bus makes this sensor directly accept input from an external 3-axis compass to provide a 9-axis MotionFusion output. Along with run-time calibration firmware and 6-axis integration, this sensor is favored by manufacturers for being simple, cheap, and effective for motion tracking.

DS18b20 is a digital temperature sensor which provides configurable 9 to 12-bit temperature readings (from Dallas Semiconductor datasheet). This sensor measures a huge range of -55°C to 125°C with approximately 0.5°C accuracy at the range of -10°C to 85°C. Frequently applied in thermally sensitive systems, DS18b20 is also able to be attached for the utilization of thermometers.

ESP32 is a single 2.4 GHz combo chip of Wi-Fi and Bluetooth designed with the technology of TSMC ultra-low power 40nm (from Espressif Systems datasheet, 2019). Power to keep ESP32 alive is not excessive due to low duty cycle usage.

While the sensors are responsible for bio-marking and psycho-marking, socio-marking is handled by Android GPS Location to track location along with 3rd party social API to track digital activity of the user. While using this device, users are obligated with privacy safety, which all data of the users will only be used in case of keeping safety of human life.

BAB 3

RESEARCH METHOD

1. Research Steps of Method

Steps of method for this research is elaborated in Fig. 2.

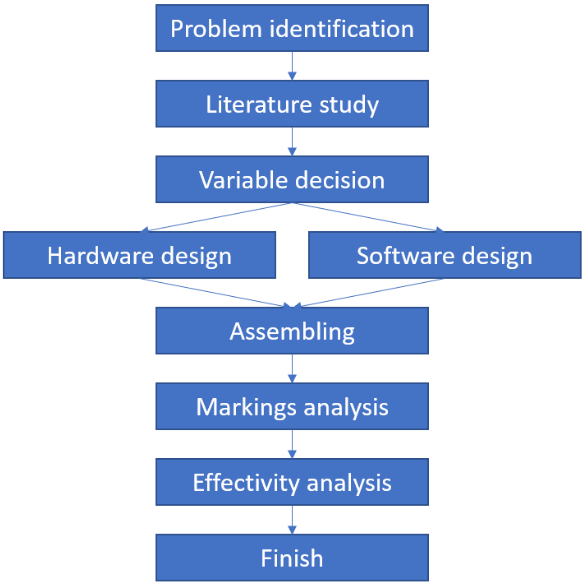

Fig. 2. Research Steps of Method

In literature studies, details from previous research are analyzed to find research limitations by reviewing future research opportunities given by corresponding researchers in the articles. Several data from datasheets are also used as the key for parameter selection.

2. Variable Decision

Several variables are chosen for the IoT life inspector, such as pulse oximetry, heartbeat rate, motion, location, and body temperature. The chosen variables are combined together to analyze symptoms of human unwellness as shown in Table 1 and Table 2.

Table 1. Symptoms of human unwellness

Unwellness	Parameters
Cardiovascular disease (bio)	Heart beat rate, temperature
Respiratory disease (bio)	Pulse oximetry
Tripping and another injury (socio)	Motion, location
Neonatal disease (bio)	Heart beat rate, temperature, pulse oximetry
Digestive disease (bio)	Heart beat rate
Depression, anxiety (psycho)	Temperature, heart beat rate, online emotional analysis service API

Conflicts (socio, digital)	Location, motion, online emotional analysis service API

3. Design and Assembling

Hardware design involves wiring and assembling modules into a device, meanwhile software design involves programming and setting up MQTT and dashboard. In this research group, hardware and software design is divided into a list of contributions as elaborated in Table 2.

Table 2. Lists of design and assembling contribution

Job Division	People in charge
Software	Husni Adnan, Refiana Ogam, Rifaudin Sakroni, Eugenia Limmuel
Hardware	Husni Adnan, Refiana Ogam, Eugenia Limmuel

4. Note to Confidential Data

Some data of this research is considered to be confidential due to ongoing research in the related topic. Hence, details about dimensions of PMSM by its conventional and modified design are hidden and only be used by corresponding researchers.

5. Analysis

Marking analysis involves four essential aspects of bio-marking, psycho-marking, socio-marking, and digital marking. Bio-marking is an aspect of human physical wellness. Psycho-marking is an aspect of human mental wellness. Socio-marking is an aspect of human social wellness. The last aspect of digital marking is the parameter which is obtainable by doing data acquisition from third party emotional analysis tools API. Effectivity is rated on how this device is able to be mass-applicated. Another note to this project is that socio-marking and digital-marking aspects are still in the stage of trial and optimization.

CHAPTER 4

RESEARCH TIMELINE

Research timeline is elaborated at Table 1.

Table 1. Research Timeline

STEPS	WEEK			
	1	2	3	4
Problem identification				
Literature study				
Variable decision				
Design				
Assembling				
Marking analysis				
Effectivity analysis				
Research report writing				

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