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Proposed ICT-based New Normal Smart Care System Model to Close Health Gap for Older the Elderly

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Abstract

At the time of entering the super-aged society, the health problem of the elderly is becoming more prominent due to the rapid digital era caused by COVID-19, but the gap between welfare budgets and welfare benefits according to regional characteristics is still not narrowed and there is a significant difference in emergency medical access. In response, this study proposes an ICT-based New Normal Smart Care System (NNSCS) to bridge the gap I n health and medical problems. This is an integrated system model that links the elderly themselves to health care, self-diagnosis, disease prediction and prevention, and emergency medical services. The purpose is to apply location-based technology and motion recognition technology under smartphones and smartwatches (wearable) environments to detect health care and risks, predict and diagnose diseases using health and medical big data, and minimize treatment latency. Through the New Normal Smart Care System (NNSCS), which links health care, prevention, and rapid emergency treatment with easy and simple access to health care for the elderly, it aims to minimize health gaps and solve health problems for the elderly.

Keywords: *Health Inequality, Super-Aged Society, New Normal Smart Care System(NNSCS), Location-Based Technology, Motion Recognition Technology*

1. Introduction

At the time when the elderly population aged 65 and over reached 16.5% (2021, the Ministry of Health and Welfare), the COVID-19 aftermath has led to digital gaps as well as age and region, emerging from various perspectives. According to the government's social welfare direction, the government is pushing to solve problems such as the development of a next-generation social security information system and a welfare blind spot excavation system, but its effectiveness and performance have yet to be revealed. There is also a gap in welfare benefits and balance depending on the urban and rural areas, especially on the status of access to emergency facilities. This study proposes an ICT-based New Normal Smart Care System (NNSCS) model from a microscopic perspective to address health and medical problems most needed in the Seoul Metropolitan Government and Rural Senior Citizens Survey (2020, Seoul Senior Citizens Survey, Chungju Dam Hyo

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Nanum Welfare Center, etc.).

NNSCS is collectively known as an integrated care system that uses mobile devices and wireless networks to manage healthcare, predict and diagnose diseases, detect risk signals and prevent accidents, and system emergency treatment in an appropriate time by sending signals and bio diagnosis information to relevant medical institutions. By applying location-based technologies such as IMU (Inertial Measurement Sensor) and AHRS (Sensor Convergence Machine) with smartphones and wearable bands (Watch) and smart plugs, real-time measured daily life patterns and personal bio diagnosis information data were stored on secure cloud servers. Implement a system that is transmitted with signals to pre-registered emergency medical facilities in case of an emergency. NNSCS is expected to reduce the health and medical gap between regions of the elderly and vulnerable in welfare blind spots and minimize risks to improve the quality of life of the elderly.

2. Technology Trends in Smart Care

2.1 Definition and Scope of Technology

Smart (health) care is an intelligent service that combines digital technologies such as cloud, big data, Internet of Things, and artificial intelligence with healthcare, which monitors the health status of individuals in real time and manages them with customized care.[1] Since COVID-19 outbreak, the market for customized healthcare has been expanding as the direction has been shifting from treatment-oriented to health care and pre-prevention. Components can be divided into data fields that collect, store, and manage personal data such as heredity, health, and medical information, platform fields that use artificial intelligence to create health care and medical services, health care devices that monitor personal bio-signal measurements.

2.2 Technology and Industry Trends

International Trends

ICT companies that commercialize new concepts of medical care by combining the cutting-edge technology trends with healthcare are notable. Figure 1 shows major international device products that provide services with personal health care devices combining existing wearable devices and smart technologies.

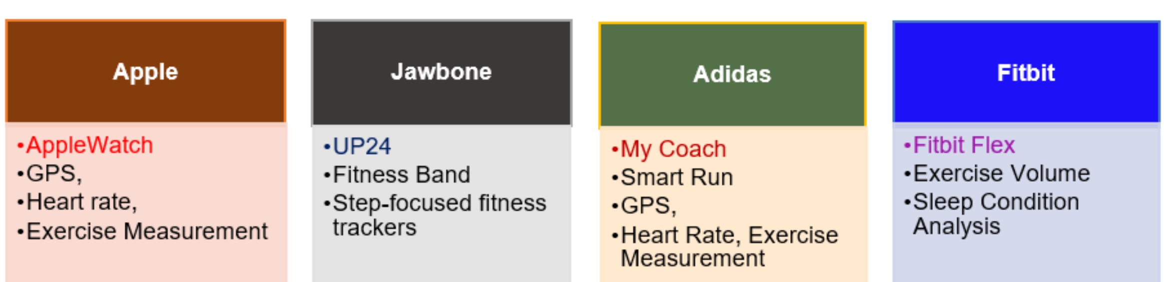

Figure 1. Personal international device products

Domestic Trends

Health care service technologies such as chronic diseases, telemedicine, and SW technologies are being developed by pioneering new markets. It is also conducting standardized research on medical data for medical institution-centered AI and Common Data Model (Seoul Asan Hospital: Asan Kakao Medical Data, Samsung Medical Center: PRO(Patient Reported Outcomes), etc.). Table 1 shows South Korea's major healthcare device products and startup products that are in the spotlight for next-generation technologies.

Table 1. Domestic healthcare device products

Manufacturer	The product	Function
Samsung Electronics	Galaxy Gear	GPS, heart, stress, sleep.
Inbody	Body Components Analyzer	Analysis of Body Components
i-SENS	CareSens	Blood Glucose Monitoring System
Healthrian	WearECG12	Body measure Electrocardiogram
BrainCommerce	Aimo	Infant biometric data collection device
Huino	MEMO Patch	ECG measurement
Welt	Smart Belt Pro	Fashion Belt & Health Tracker

Industrial Trends

Global healthcare industry growth prospects were positively evaluated by ABI Research, Frost & Sullivan (2018), Allied Market Research, and others and the global industry, excluding pharmaceuticals and bio, is reported to account for 30% of the total healthcare market with $669.5 billion in 2019. Additionally, the growth of smart healthcare sectors such as pre-diagnosis of diseases, innovative medical devices capable of health management, in vitro diagnosis, and the use of artificial intelligence technology that supports CDSS (Clinical Decision Support System) are becoming common.

3. Related Technology Research

3.1 Location-Based Services (LBS) related technologies LBS

Location-based services combine location information of moving users with surrounding information to provide necessary services, using acceleration sensors, gyro sensors (MEMS) and geomagnetic sensors that detect and increase accuracy under smartphones and wearable environments.

Acceleration Sensor

It measures the gravitational acceleration of an object based on gravitational acceleration by dividing it into three vectors, the X, Y, and Z axes, when it is stopped. It is used to grasp slopes or vibrations with certain values even at rest, and has the disadvantage of being strong in error over time, but not being able to measure the angle of rotation (defense) on a vertical side.

Gyro Sensors

A gyro sensor is a sensor that measures angular velocity (the number of movements per second) and detects angular velocity using a physical phenomenon in which the direction of velocity and the force of Corioli, a vertical forward force, occur when an object with a velocity, are rotated. $Fc = 2mv*\omega$

(Corioli's force (F) acting on mass (m) is the vector product of velocity (v), angular velocity (ω))
The MEMS gyro sensor converts the measurement of Corioli's force into an electrical signal to produce angular velocity. The tuning fork method is a method of placing two constantly vibrating pendulum in the opposite direction so that it can be measured in any direction.

The gyroscope has inertia to maintain the rotational force regardless of the slope, which is the physical property of the top, and measures the azimuthal angle of rotation of all axes that cannot be measured by acceleration sensors. It is used as a gyro sensor by adding a device that generates electrical signals to the rotational repulsive force and recognizes motion on three axes and the combination of gyro scope and acceleration sensor, which can accurately detect balance and stereoscopic sense, enables accurate localization. A gyro scope sensor that detects up, down, and down movements can be used to recognize various movements.
Geomagnetic Sensor

A sensor that detects Earth's magnetic force measures magnetic values in the X, Y, Z, and tri-axial directions to determine the magnitude and direction of the magnetic field. The Magneto Resistance (MR) sensor, which has a magnetic resistance effect, is a sensor that measures the size of disturbance using electrical resistance changes with magnetic field and is used for motor rotation and positioning in addition to geomagnetic measurement.

MI (Magneto Impedance) sensor is part of the special self-impedance, the amorphous wires with the application, terrestrial magnetism sensor hall sensor sensitivity more than 10,000 times better than his next generation of high precision measurements are possible by subtle changes that are occurring. Not only is it used for defense measurement (electronic compass) of ultra-low consumption current, but it is also used for applications that utilize high sensitivity characteristics such as location measurement in buildings and detection of metal foreign substances.

3.2. IMU (Inertial Measurement Sensor)

It is a sensor that measures inertial forces and is a composite inertial measuring device that has acceleration sensor, gyroscope sensor and local government sensor. The IMU sensor, which includes a three-axis geomagnetic sensor, is composed of nine axes, allowing perfect measurement of the location you want to know and can be applied mainly to smartphones with low consumption power.

In this study, an IMU sensor and AHRS were installed on an easy-to-use and accessible smartphone or smartwatch device and daily life patterns are collected and analyzed through data measuring the exact location and movement of elderly people in blind spots of health, and used for correct posture, pedestrian correction, risk detection, and prevention.

Figure 2 illustrates the AHRS model with MPU-9250, MEMS MotionTracking device of InvenSense.
AHRS stands for Attitude, Heading Reference System. It is often referred to as Magnetic, Angular Rate, and Gravity (MARG), primarily as a system for converging IMU sensors and Magnetometers to find positions and absolute azimuths.

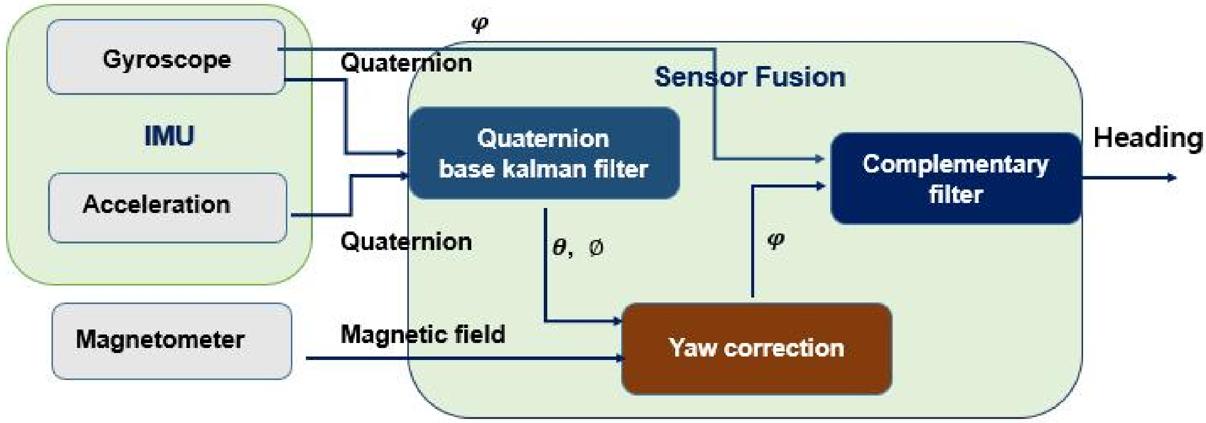

Figure 2. Sensor fusion with invensense's MPU-9250

4. NNSCS Model Study

4.1. NNSCS(New Normal Smart Care System)

First, the NNSCS model can utilize smartphones, wearable devices (smart watches or bands) and wireless networks as the basis, making it relatively inexpensive and easy to operate. Second, it is a mobile-based healthcare that enables basic health care anywhere with wireless networks such as pulse, electrocardiogram, blood pressure, and body temperature and is easy to carry. Third, it is easy to utilize security and big data information by using personal mobile devices and using cloud servers from telecommunication companies. Fourth, the NNSCS model is a system that integrates and connects individuals, regions, local governments, and medical health facilities, enabling various service links through connections with the Internet of IOT objects and free devices around it. Although smartphones and wearable devices equipped with communication are required as a prerequisite, the majority of the elderly use smartphones (66.9% owned by senior citizens, 96.6% text messages, Kakao Talk, Internet search, 60% or more of basic apps), and the NNSCS model proposal is reasonable.

4.2 Structural Model of the NNSCS

Figure 3 is a system design that utilizes self-data through transfer learning. So that elderly people who are vulnerable to health care and daily life patterns can be checked through simple manipulation by smartphones and smart bands, and information notification service through disease prediction and diagnosis.

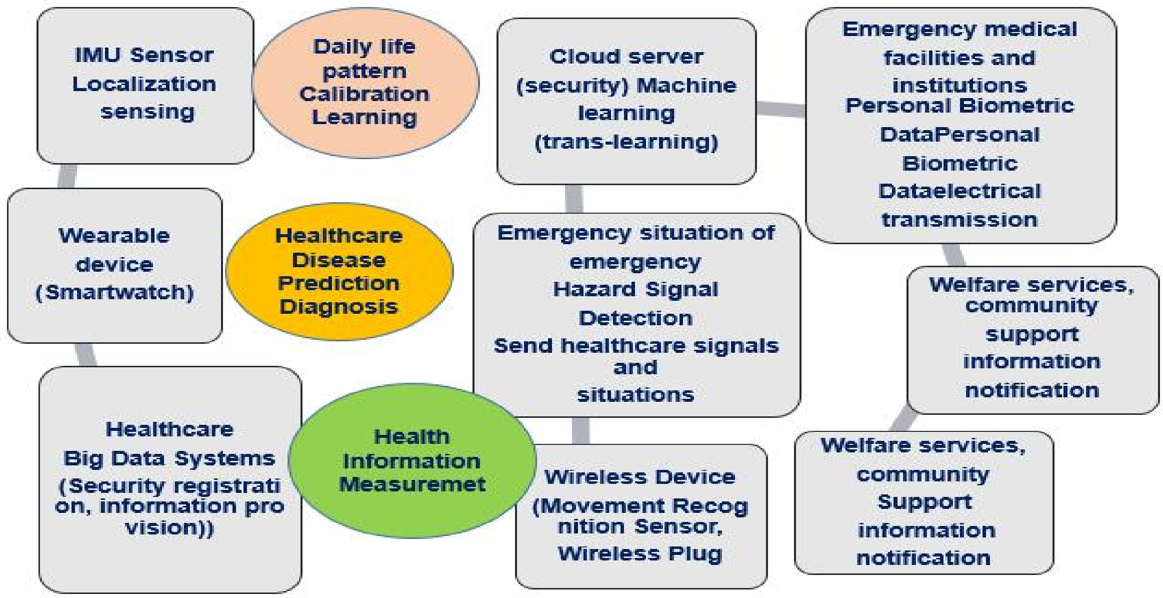

Figure 3. New normal smart care system process structure

From a user perspective, the process process is:

First, it measures daily life patterns in real time with location tracking data that increases accuracy with IMU sensors in smartphones and wearable devices

Second, I register smart care systems using smart bands or smartphone applications and sign up after agreeing to send my health information or biometric information to registered medical institutions only in case of emergency or on request for personal security.

Third, relevant medical information, disease control, and prevention information can be notified from time to time through the health and medical big data open system.

Fourth, the New Normal Smart Care System uses a one-stop platform that connects users, medical institutions, senior citizens, and public institutions beyond the existing healthcare or risk notification signal-based healthcare concepts, but personal data is generated from smart devices and stored on private cloud servers without consent.

Fifth, medical and health care information is provided by big data systems related to medical institutions and elderly facilities, and personal information is sent only to linked registration institutions in case of emergency or if necessary.

Sixth, the app for gait patterns and posture correction, nutrition notification, and blood pressure electrocardiogram shows the timing of disease prediction and treatment with self-managed and learned data.

Seventh, the New Normal Smart Care System Management Agency reduces digital blind spots through regular online and offline management of problems and pre-postal management to solve them.

Figure 4 shows the NNSCS model that uses smartphones and wearable devices to connect physical, mental, and social health and spatial components of the elderly.

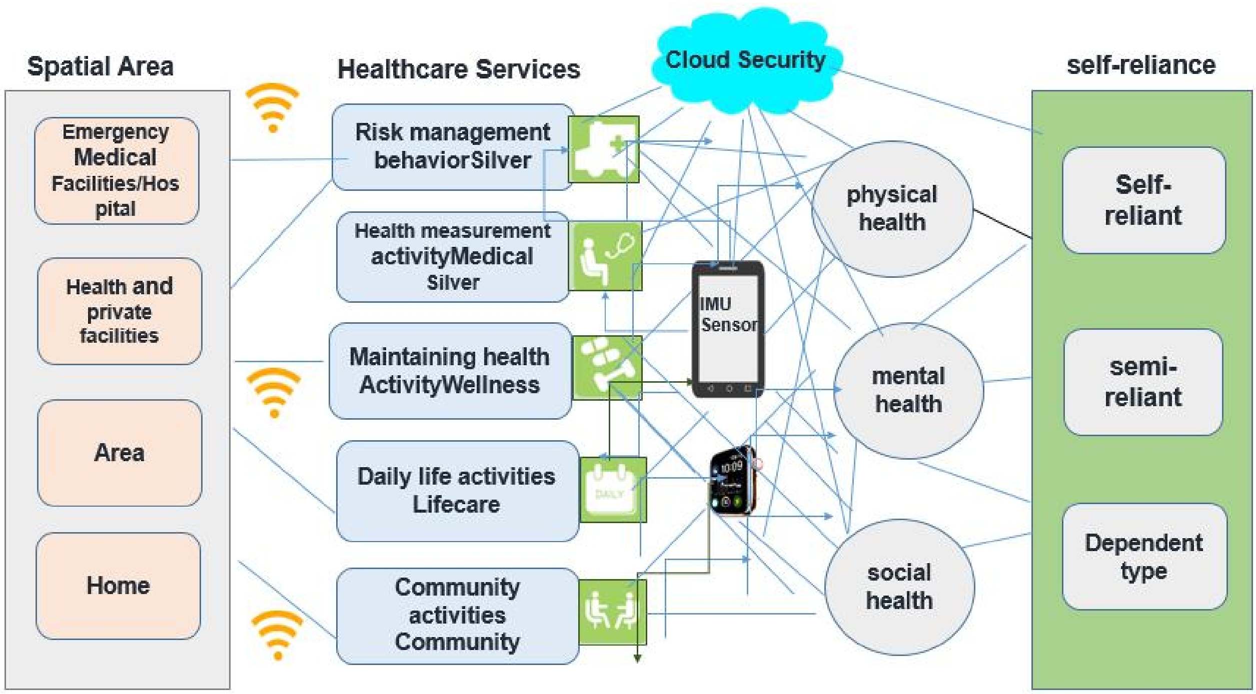

Figure 4. NNSCS model for elderly health support elements

5. Conclusion

This study designed an integrated care system that analyzes location-based technology and everyday life patterns through transfer learning in micro-approaches to receive self-diagnosis, prediction, management and information needed in the overall retirement life as notification services. Macroscopic minimum living security or public services are expected to be resolved into the next generation of social security information systems and welfare blind spot discovery systems to secure their limitations starting in 2022. As the spread of smartphones became more common, we proposed a smart care system model for the digital age under a simple and accessible environment. In the future, there is a need for comparative analysis from the perspective of users and service providers and research on smart welfare service development suitable for the New Normal era.

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