UNIVERSITY OF NAIROBI

COLLEGE OF BIOLOGICAL AND PHYSICAL SCIENCES

SCHOOL OF COMPUTING AND INFORMATICS

Use of Wearables in Health Monitoring among Long Distance Truck Drivers for Predictive Analysis.

BY

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P51/11430/2018.

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An exploration project submitted in incomplete satisfaction of the necessities for the level of Master of Science in Applied Computing of the University of Nairobi

Presentation

I **FAITH NKIROTE KINYUA** do hereby declare that this project is my original work and has not been presented for any degree in any other university.

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Date 6th September, 2020

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Date 6th September, 2020

Acknowledgement

To start with, I want to express gratitude toward My Maker for enabling me to finish this examination project.

Besides, I recognize the commitment and support from my loved ones for showing interest in my examinations and keeping me in their supplications.

My genuine appreciation goes to my administrators, Peter Waiganjo Wagacha, and Samuel Ruhiu. Your direction, moral help and administrative abilities gave me the consolation to proceed with the undertaking. Much thanks to you for saving time in your bustling timetable to meet me and guide me through. You have imparted to me your insight earnestly thus may the Almighty God favor you.

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List of abbreviations

BP	Blood pressure
COVID	Corona Virus Disease
DMAS	Driving Monitoring and Assistance Systems
ECG	Electrocardiogram
EDA	Electro Dermal Activity
EMG	Electromyogram
HGV	Heavy Goods Vehicle
RR	Respiration rate
SpO2	Arterial oxygen saturation
UI	User Interface
VIS	Vehicular Information System

ABSTRACT

This examination analyzed the utilization of wearables in wellbeing checking among significant distance transporters for prescient investigation.

The reason for this examination was to distinguish wellbeing factors that influence driving execution among significant distance transporters, assess the impact of chronic weakness on their driving presentation and to create and assess a minimal expense wearable gadget for catching and observing transporters' wellbeing information for prescient investigation.

The objective populace contained passing organization directors and significant distance transporters from 3 organizations in Kenya. It is an investigation where polls were directed to the directors, centered gathering conversations and meetings led among the significant distance transporters.

From the discoveries, Majority of the respondents had mishaps because of wellbeing related causes. High instances of hypertension and resting apnea were likewise recorded as their primary wellbeing challenge. Others revealed abrupt passing of certain drivers because of stroke and respiratory failure.

The outcomes gave a guide to observing the transporter's wellbeing and giving exact forecast examination on their wellbeing to stay away from fatal infections like stroke and respiratory failure.

Further suggestions have been made to have a model observing a more extensive scope of indispensable including glucose, oxygen immersion and respiratory rates. The prescient examination part could likewise be consolidated as a feature of the actual model with the goal that it very well may be done naturally after a specific time stretch.

1 CHAPTER ONE

1.1 Introduction

This section gives the foundation of the examination, the portrayal of the issue, the goals of the exploration, the examination questions, the framework targets, the significance of the exploration and the extent of exploration.

1.2 Background information

Driving is a perplexing errand that requests one to collaborate appropriately with the vehicle and the natural conditions simultaneously. Hence, it is fundamental to see, measure, and decipher the data precisely, just as to choose and play out the fitting street practices (NZTA, 2009). This cycle happens in middle of the communication with a not insignificant rundown of elements that impacts the presentation of drivers, like insight, driving capacities, mentalities, solicitations and assumptions, just as physical, mental, passionate wellbeing, and the conceivable utilization of prescription to treat various sorts of ailments (NTC, 2003; NTC and FORS, 1997).

Several assessments have shown that each infection, paying little notification to its etiology, impacts driver's capacities (academic, knowing, engine, decisional, and so on) deficiently and thusly our lead, influencing similarly the adequacy of the driving presentation (Useches, Cendale, Alonsos, and Serges, 2017; Useches, Serges and Alonsos, 2015). Essentially, it is noteworthy that individuals' show directing the boat might be affected by a sickness, by impermanent diseases, and by the climate wherein they live, work, and drive. Certifiable scenes of average deficiency conditions - including pressure, rest disturbing effect, stomach disturbs, diseases, cerebral agony, migraine, influenza, absurd colds, fever, and so on, and the treatment for these conditions can induce perilous driving. Also, significant length ailments, their signs or the clinical treatment for them may comparatively discourage a driver's capacity to drive securely.

Notwithstanding, the evaluation of wellbeing for driving doesn't just rely upon the presence of a clinical determination however on the danger and danger that such finding addresses out and about (Dobbs and Carr, 2005; Odenheimer, 2006). In this unique circumstance, comprehend in

case drivers' consideration centers around mental conditions or on the actual ones when their ailment deteriorates. Hence, the driver determination framework permits us to comprehend this since it limits—in a pretty much verifiable way—the significance of the conceivable mental adjustments. Indications of medical issue, for example, ongoing infection can influence driving because of the weakening of physiological and mental limits and capacities.

Wearable contraptions can screen and record constant data about one's physiological condition and improvement works out. Wearable sensor-based flourishing seeing frameworks may incorporate various kinds of flexible sensors that can be made into material fiber, pieces of clothing, and versatile social events or plainly connected with the human body. The sensors are useful for evaluating physiological signs like electrocardiogram , electromyogram, beat, internal warmth level, electrodermal movement, vein oxygen immersion , circulatory strain and breath rate (Pantelopouloss A. et al,2016, Nematis E. et al 2012).

Without consciousness of wellbeing or natural weakening while at the same time driving, drivers may require a more extended response time to deal with crises and become effortlessly associated with auto collisions (Taylor A.H et al (2006) in this way representing a threat to different drivers, travelers, people on foot and property.

Arising detecting innovations upgrade medical care with unavoidable and nonintrusive wellbeing information assortment, which has been considered as a foundation innovation for irregularity recognition, mediation, and successful administration (Yang et al (2015), Banaee et al (2013), Taking benefit of detecting, portable processing, and correspondence advances, M-wellbeing has been demonstrated to be a compelling strategy for further developing wellbeing and wellbeing administrations as clinical suggestions, tele-observing, and versatile wellbeing help (Daniel et al (2016). As a consistent, fanciful, horrible, and delicate undertaking, driving can be upset with different segments, from the thriving status of the driver to the climate in the vehicle. Late appraisals have zeroed in on driver's lead related genuine status, i.e., sharpness, drowsiness and fatigue (Eshed et al(2015), Sun et al (2014).

This is a significant issue that should think about how to see the wellbeing status and the unsafe natural circumstance and how to offer supportive types of assistance to the driver in order to forestall the approaching mishap. Be that as it may, late examinations have not given a thorough and direct strategy for dealing with the driver's wellbeing, just as offering the fitting types of assistance for safe driving. Consequently, the medical care administration framework that can screen different essential signs through different sensors during driving and give fitting

notice, proposals, and surprisingly conceivable disconnected crisis administrations is exceptionally alluring for transporters or drivers experiencing persistent sicknesses. By exploiting the detecting foundation and advances given by brilliant urban areas, more astute wellbeing administrations can be accomplished to organize existing assets (data or administrations) to fulfill the customized prerequisites of the drivers as per the examination of constant tactile information, which can be considered as savvy wellbeing (s-Health (Solanas et al (2014).

Notwithstanding, Greenfield et al,(2016) contends that Wearable gadgets may offer additional opportunities for working on the wellbeing and prosperity of significant distance transporters. He adds that Drivers know about their undesirable way of life thus keen on changing their way of life and wellbeing. Further prescribes Future examination to look at the effect of wearable gadgets on working on the wellbeing and prosperity of expert drivers.

1.3 Problem statement

Drivers' prosperity and wellbeing are central sections to expect execution results and to actuate road security. It's undeniably a reality that drivers with (physical and invigorated prosperity) lacks or issues have more probabilities of being associated with minor mishaps and suffering (or) a couple of wounds. Thriving status impacts the security of drivers (Hakkanen et al,2000).

In excess of 300 destructive two vehicle 18 wheeler occurrences were reviewed in one appraisal (Hakkanen et al, 2001). The likelihood of being primarily answerable for a catastrophe stretched out by a factor of 3.5 if the driver had a persistent ailment. One evaluation (Jovanovic et al, 1998) detailed that drivers with cardiovascular infection were twice as slanted to have a fiasco and to blame than were sound drivers. In different assessments, diabetic gigantic distance transporters will without a doubt have a mishap than were nondiabetic drivers (Laberge-Nadeau et al,2000). Enthusiastic illnesses have likewise been associated with broadened mishap relationship among more pre-arranged drivers (. Hemmelgarn et al, 1997). There is no examination on the impacts of harshness on driver risk, however late proof proposes that droop impacts mental working (i.e., attentional cycles) (Farrin et al, 2003).

Huge distance carriers' long and unusual working hours are connected with absence of rest which prompts sleepiness, bad temper, confusion, similarly as debilitated thought, survey, reaction time, deftness and watchfulness level (Phillips and Sagberg, 2013). Exhaustion by and large is a critical risk for driving prosperity of carriers (Adams-Guppy J, Guppy A.2003). Their

fixed work style and being ceaselessly all over town allows less opportunities to work out (Turner and Reed, 2011) and permission to great food and keep a reasonable eating routine, which significantly sway drivers' success and execution at work. Carriers are similarly hard to follow prosperity headway interventions as they invest expanded times of energy driving making the rounds (Birdsey J,et al 2015)

1.4 Research Objectives

1. To assess the impact of chronic weakness on driving execution among significant distance transporters.
2. To distinguish wellbeing factors that influence driving execution among significant distance transporters.
3. To develop and evaluate a low cost wearable device for capturing and monitoring truck drivers' health data for predictive analysis

1.5 System objectives

1. To create and develop an integrated health monitoring wearable to monitor the health of long distance truck drivers
2. To design and implement predictive analysis model on the data captured from the long distance truck drivers

1.6 Research questions

1. Which health factors can be monitored using the wearable sensors?
2. How does poor health affect driving performance among long distance truck drivers?
3. How can technology be used to capture and monitor health data among long distance truck drivers

1.7 Significance of the study

The passing organizations in Kenya will utilize the discoveries from this investigation to set out on and support their drivers on the utilization of brilliant wearable gadgets to advance their wellbeing I.e. further developed wellbeing, drivers' security, vehicle security and decreased instances of mishaps.

The examination will likewise make attention to the transient organizations to put resources into outfitting their drivers with the savvy wearables for the individuals who have not yet done as such to work on their drivers' presentation because of good wellbeing.

The study will also be an eye opener to the entire transport sector in ensuring their drivers' health is well monitored to enhance their overall performance and prevent some terminal diseases e.g stroke and heart attack among drivers once an accurate predictive analysis has been done on their vitals.

1.8 Scope of study

The researcher carriedout the study from a sample of 3 fleeting companies from the total of 5 within Kenya. From each of the 3 companies, 2 managers were involved. The researcher also engaged a sample of 68 long distance truck drivers from the same population.

From the target population, the researcher investigated on the health factors affecting driving performance among the truck drivers, the effect of poor health on their driving performance and further developed a low cost wearable device for capturing and monitoring truck drivers' health data to be used in predictive analysis.

2 CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter reviewed literature related to use of health monitoring wearables (sensors) in driving from both the global as well as the local perspective. The research included an evaluation of which driver's health vitals need to be monitored. Another important aspect of the review included how the implementation of the integrated wearable system could monitor truck drivers' health and later use the data for predictive analysis. The research also evaluated the health monitoring system evolution and models including sample cases that have successfully been implemented.

2.2 Wearables

Wearable gadgets, or just recommended as 'wearables' are sharp hardware or PCs that are joined into various types of embellishments comparably as things of dress and can be worn on or appended to the body (Wright and Keith, 2014). These gadgets are wanted to give the clients a joined and consistent experience that have for a long time been commonplace from the PCs. The standard accommodation of wearable contraptions is to assist client with accomplishing a condition of related self by utilizing sensors and programming that work with information trade, correspondence and data access tirelessly. As such, wearable gadgets are a huge piece of the snare of things (Swans, 2012; Castillejos et al., 2013; Hirematths et al., 2014; Wangs, 2015; Suns et al., 2016).

Appeared differently in relation to cutting edge cells and PCs, devices offer customers more convenience. This convenience can be credited to their light weight, accessibility, likelihood to use while the customer is moving, credibility to use non-console orders, for instance, voice and hand signals, and giving the customer control. Not solely are these contraptions overall saw as 'development', anyway various customers furthermore consider wearables 'plan' (Hein and Rauschnabels, 2016). Wearables could moreover outflank PDAs and PCs execution and accordingly might possibly supersede these developments later on. As needs be, there has been an addition in customer's care and data about these devices similarly as specialist's propensity to convey new wearable contraptions to the market (Parks et al., 2014).

Wearable contraptions can screen and record progressing information about one's physiological condition and development works out. Wearable sensor-based prosperity checking systems might incorporate different sorts of versatile sensors that can be joined into material fiber,

pieces of clothing, and adaptable gatherings or directly associated with the human body. The sensors are prepared for assessing physiological signs like electrocardiogram, electromyogram, beat, interior warmth level, electrodermal development, vein oxygen inundation, circulatory strain and breath rate (Pantelopoulos A. et al,2016, Nemati E. et al 2012).

Also, smaller than usual electro-mechanical structure (MEMS) based little development sensors like accelerometers, whirligigs, and alluring field sensors are by and large used for assessing activity related signs (Deen M.J.2015), (Hong Y. et al 2010). Relentless checking of physiological signs could help with distinguishing and examine a couple cardiovascular, neurological and aspiratory ailments at their early phase. In like way, consistent seeing of a person's improvement exercises could be helpful in fall disclosure, step model and position evaluation, or in rest assessment. The wearable success seeing designs are routinely outfitted with a mix of electronic and MEMS sensors, actuators, far off correspondence modules and sign dealing with units.

Arising detecting advances improve medical services with unavoidable and nonintrusive wellbeing information assortment, which has been considered as a foundation innovation for anomaly recognition, intercession, and compelling administration (Yang J. et al, 2015), Banee H. et al (2013). Exploiting detecting, versatile figuring, and correspondence innovations, M-wellbeing has been demonstrated to be a powerful technique for further developing wellbeing and wellbeing administrations as clinical suggestions, tele-observing, and portable wellbeing help (Free C.N, 2010), (Daniel K, 2016), (Paganelli J, 2011). As a predictable, diserse, disturbing, and fragile errand, driving can be irritated with different components, from the thriving status of the driver to the climate in the vehicle. Wellbeing components to be observed utilizing wearable sensors

Generally, the intelligible creating features the unfriendly outcome on driving while at the same time experiencing some physical or energetic flourishing disease(s). Through the new affirmation, it has been shown that the going with express conditions might weaken drivers both mentally as physiologically: unequivocal disclosures (Fildes ., 2000), like neurological issues (Charlton ., 2004; Dobbs, 2005), dementias (Carr, 1997), having experienced a stroke (Koepsell et al., 1994), diabetes (Kagan, Hashemi, and Korner-Bitensky, 2010), hypoglycemia (Seeger and Lehmann, 2011), eye issues (Owsley, Stalvey, Wells, and Sloane, 1999), macular degeneration (Owsley, Ball, et al., 1999) glaucoma (Haymes et al., 2007), rest apnea (Teran-Santos, Jimenez-Gomez, and Cordero-Guevara, 1999), diseases identified with improvement

like rheumatoid joint aggravation (Charlton et al., 2004; Dobbs, 2005), and osteoarthritis (Sims, McGwin, Allman, Ball, and Owsley, 2000), and uncommon assaults experienced while driving (Tervo et al., 2011). The majority of these issues are controlled/stuffed in the designs of evaluation of drivers utilized in Spain and in other different nations. In that capacity, there is some level of control on drivers with a particular confirmation and the data they get or ought to get.

All things considered, other unequivocal and brief diseases or coincidental impacts (for example cold, influenza, migraines, contaminations, fever, stomach changes, cerebral miseries with disarray, centering troubles, and hardships in coordinating squeezing factor) (Ozcoidi, Valdes, Simon, and Gonzalez, 2002) sicknesses (contamination and skeletal muscle torments, deafness, and so forth), and solution for treat the various types of issues (RoSPA, 2010), likewise sway the driver's reaction conflictingly, compromise actually the driving execution, and expansion the danger to crash (Charlton et al., 2004; Prada et al., 1995). This store of conditions might influence focus, getting, disposition, data dealing with, and the capacity to turn one's head or to play out the central moves. The outcomes verifiably gave that it was conventional indications or ailments (laziness, languor, cerebral pains, muscle torment) what caused people to feel improper to drive.

In the m-Health situation, fundamental signs, including electrocardiogram (ECG/EEG), beat, respiratory rate, circulatory strain, glucose, and temperature, can be surveyed and acquired from wearable sensors in a nonintrusive manner. The patient's information, including appearances and key signs, is collected by the cell phone through User Interface (UI) correspondence or straightforwardly from sensor gadgets.

The clinical suggestion or cautioned associations can be given when the states of the patients crumbles. In (Cheng D. Y. et al,2011), a clinical thought association framework is proposed in which the patient's essential signs are gotten from the sensors and some time later envisioned as line follows for the patients, family members and subject matter experts.

These significant signs are essentially collected and shown short any additional assessment. Tele-checking of the patients' interminable turn of events or innovative conditions has been finished in ceaseless appraisals. The pressing signs and general signs are gotten from the report of the patients, and a brief time frame later the collected not settled forever into hazard scores through essential evaluation. The unavoidable outcome is given to clinical staff for help and to the patient for notice (Daniel A.et al,2016).

A secretly settled predictable idea structure is proposed to give upsetting or empowering associations to family members or clinical staff with respect to the allowance on the material information acquired from biomedical and standard sensors (Paganelli F., Dino G, 2011). The considerable information is bankrupt down as per the setting suspecting which picks the event to trigger the alarm.

Driving is an erratic situation that is delicate to the exercises of the driver. Late evaluations revolve around the driver's lead related genuine status, i.e., sharpness, apathy, and weakness.

The disconnected heartbeat are surveyed through the nonintrusive stuff and taken as the pointers of the driver's heart flourishing state (Sun Y. et al (2014), Jung S.J. et al (2014). Visual sensors (cameras) are widely used as a nonintrusive methodology by killing the facial part or the eye headway to screen and see sagaciousness or exhaustion during driving (Eshed O. et al, 2015), Boyraz P. et al, 2012).

The beat inconsistency, circulatory strain, temperature, speed, and level of eyelid end are created to expect and isolate the driver's watchfulness record. The information are amassed from sensors passed on the vehicles through a Bluetooth association and moved to the cell phone. To caution the driver's idea, a phony call association is executed and will be set off when the examination metric appears at the edge.

Wearable and adaptable sensors for client intelligent wellbeing observing gadgets

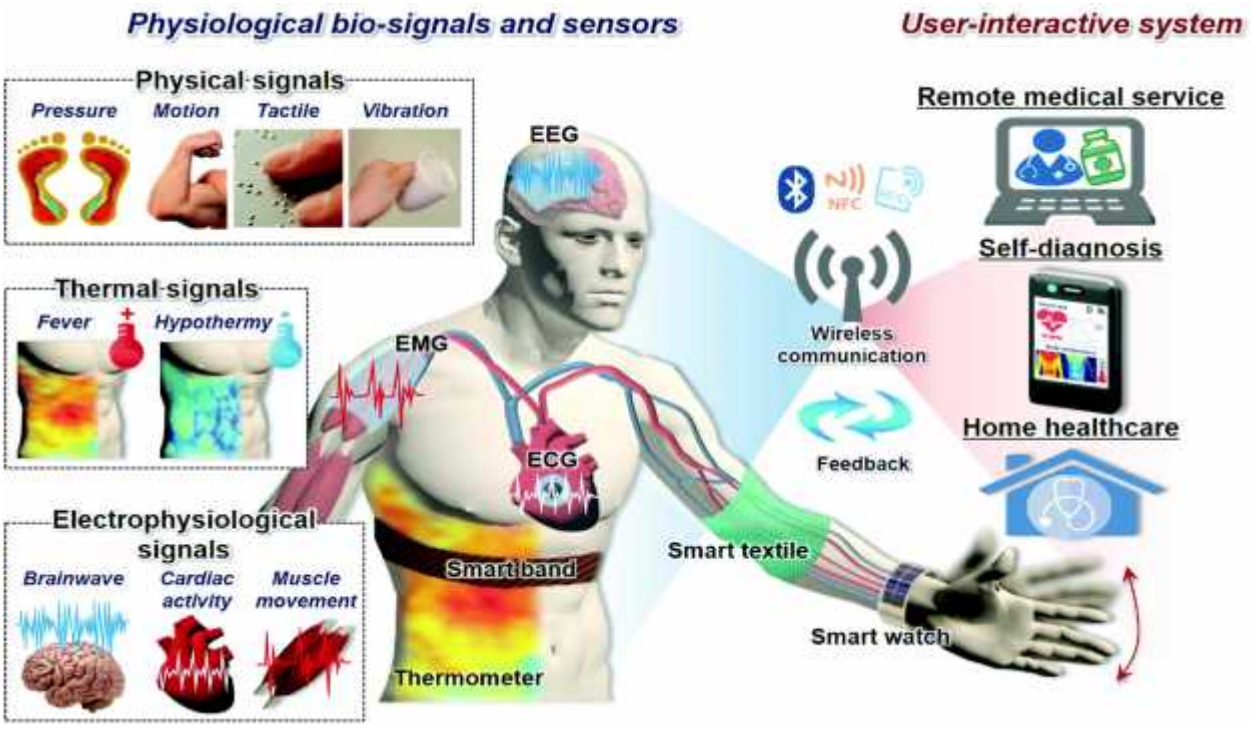


*Figure 1 Wearables and flexible sensors (*Adopted from (Muhammad et al 2019)

Multi sensor health monitoring system

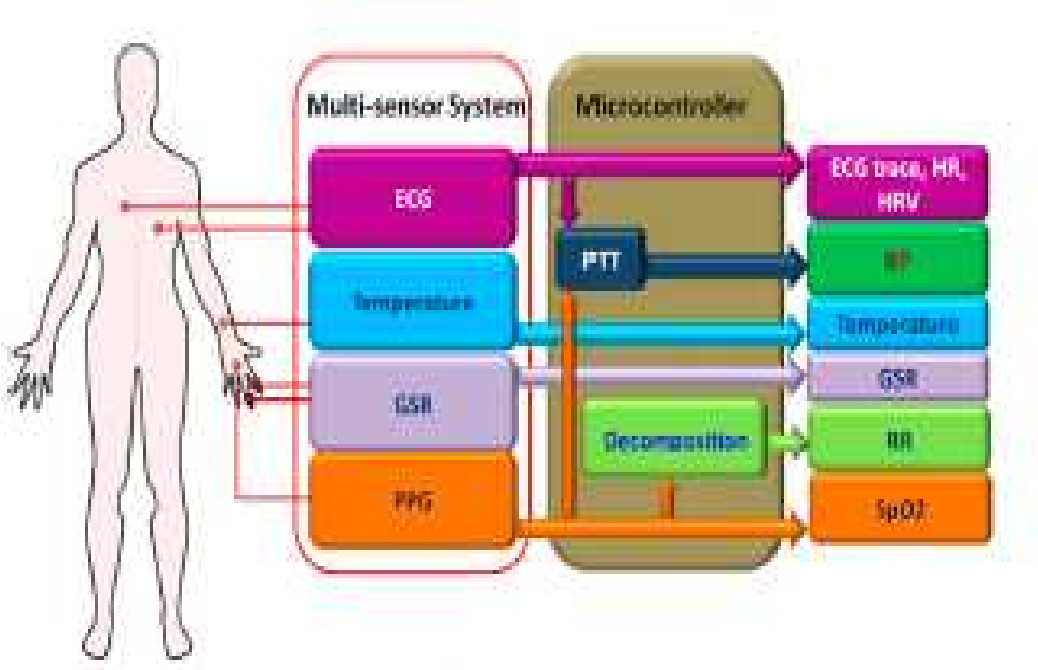


*Figure 2 Multi sensor health monitoring system (*Adopted from Sumit Majumder et al 2017

2.3 Effect of poor health on drivers' driving performance

Examination on the effect on driving of these "genuine" ailments and pathologies and its manifestations has been exceptionally broad. Therefore, preventive intercession is centered solely around its recognition and the consciousness of its dangers on traffic security. Be that as it may, there is a scope of normal sicknesses and medical issues, once in a while of more noteworthy effect in the populace, whose manifestations influence driving.

For example, some particular sicknesses (colds, influenza, cerebral pains, contaminations, fever, and stomach issues, among others) may likewise affect disposition, fixation, insight, and data handling, in this way causing drivers' negative reactions. Finally, some ailments (for example, skeletal muscle tortures and adjustments, etc) may decrease the ability to turn one's head or to play out the major moves, thusly really affecting driving. In this heap of cases, the adverse consequence on driving achieved by medication used to treat the different kinds of afflictions should be considered (RoSPA, 2010).

Wellbeing status affects the security of drivers (. Hakkanen et al,2000). In excess of 300 lethal two vehicle 18 wheeler mishaps were researched in one examination (Hakkanen et al, 2001). The likelihood of being essentially answerable for a mishap expanded by a factor of 3.5 if the driver had a constant sickness. One assessment (Jovanovic et al, 1998) declared that drivers with cardiovascular infection were twice as responsible to have an accident and to fault than were strong drivers. In various assessments, diabetic profound product vehicle (HGV) drivers will undoubtedly have an accident than were nondiabetic HGV drivers (Laberge-Nadeau et al,2000). Diligent diseases have in like manner been connected with extended setback consideration among more settled drivers (. Hemmelgarn et al, 1997). There is no assessment on the effects of wretchedness on driver danger, yet progressing evidence suggests that slump impacts scholarly working (i.e., attentional cycles) (Farrin et al, 2003).

In a companion assessment of 10,525 NewZealand people, solid drivers were twice as in danger to have a mishap (Whitlock et al, 2003), yet in considering the general flourishing effect of imposingness, these impacts have usually not been thought of . Much has been explained rest apnea condition and driver security, and a decrease in substantialness, through way of life the board (counting genuine work), could diminish the issue (Norman et al, 2000). One greater freedom might be through pharmacological parts that incapacitate driver sharpness and data managing. There is likewise the potential for disastrous lethargy in drivers utilizing sure over-the-counter prescriptions like antihistamines, sedative analgesics, and muscarinic foes (Horne JA et al, 2004), yet little is thought about the impacts of genuine work on pharmokinetics (Khazaeinia T et al, 2000).

At long last, in the United Kingdom, a figure of in excess of 18 million days of weight nonattendance is inferable from weight and its results. The National Audit Office (. Natl. Review Off., 2001) has assessed that weight related expenses are £135 million (~$237 million) for hypertension, £127 million (~$223 million) for coronary sickness, and £124 million (~$218 million) for Type 2 diabetes. Diabetic experts are in all probability going to utilize 32 days out of each period of difficulty nonattendance, while nondiabetic specialists utilized 17 days (Skerjanc A. 2001). We don't contemplate any endeavor to study the outcomes of wrongdoing (or certainly troublesome retirement because of inadequacy) on word related squeezing factor (coming to fruition because of more significant work requests set on those excess at work); this likely has epic repercussions for driver security in the vehicle business where there is a large part of the time a shortfall of able topic specialists.

Innovative difficulties of diabetes that might affect safe driving execution review visual retinopathy with related shortcomings for visual understanding, loss of outskirts vision and dull assortment; and lower limit fringe neuropathy that might affect pedal control. Genuine occasions identified with hypo-or hyperglycemia might accomplish transient academic brokenness and loss of care (Kagan, Hashemi, and Korner-Bitensky, 2010). As checked by Sommerfield, Deary, and Frier (2004), considering how the cerebrum is reliant upon a consistent inventory of glucose as its basic wellspring of energy, changes in blood glucose concentrate quickly sway cerebral cutoff. Hypoglycemia, a condition happening when blood glucose is extravagantly low, is a normal outcome of treatment with insulin and some antidiabetic cures.

Driver crippling signs meld twofold or hazy vision, shortcoming or shuddering, shivering or deadness of the skin, sleepiness or lack, jumbled reasoning, blacking out, and seizures. Compromising impacts of hypoglycemia on mental cutoff points broke down for fundamental and decision response times, speed of numerical evaluation, verbal shared trait, thought, memory, and psychomotor breaking point, when focuses decrease under 3.0 mmol/l (54 mg/dL). Genuine hypoglycemia (blood glucose gatherings of 2.5 mmol/l [45 mg/dL]) in grown-ups with Type 1 diabetes has additionally been associated with a quantifiably gigantic decrease in data preparing speed and in spatial cutoff points drawing in cognizance of the general climate, with an undeniable importance to safe driving execution (Wright, Frier, and Deary, 2009). The National Institute of Diabetes and Digestive and Kidney Diseases Information Clearing House (2008) gives the going with data about hypoglycemia when driving:

A driver's ability to accurately see various things in equivalent requires thought in the insight stage, and situation care on a very basic level depends upon it. Despite its application in the later periods of Decision and Actions, thought is essential to take in and measure the open signs. The meaning of a driver's dynamic thought developments in a lively and complex driving environment always and property security. That is the explanation a reliable checking of the driver's thought is a fundamental concern for safe driving and has been a working assessment area for a significant long time. To ensure driving prosperity after the absentminded direct of a driver is recognized, various countermeasures are gotten depending upon the nature and force of the imprudence. (Muhammad et al 2019)

As depicted in Staplin et al. (2012), driving issues might be an early indication of dementia, in light of the amazing requesting for unequivocal idea, judgment, and visual understanding. Drivers with dementia might become lost in obvious districts; they might become overpowered by re-courses or solid traffic; they might puzzle signs and signals; or they might speed up when they expect to ease off (Kaszniak, Keyl, and Albert, 1991). Different appraisals have discovered that drivers with dementia additionally experience issues seeing traffic signs (Brashear et al., 1998; Carr, Madden, and Cohen, 1991; Hunt, Morris, Edwards, and Wilson, 1993; Carr, LaBarge, Dunnigan, and Storandt, 1998).As depicted in Staplin et al. (2012), driving issues might be an early indication of dementia, in light of the amazing requesting for unequivocal idea, judgment, and visual understanding. Drivers with dementia might become lost in obvious districts; they might become overpowered by re-courses or solid traffic; they might puzzle signs and signals; or they might speed up when they expect to ease off (Kaszniak, Keyl, and Albert, 1991). Different appraisals have discovered that drivers with dementia additionally experience issues seeing traffic signs (Brashear et al., 1998; Carr, Madden, and Cohen, 1991; Hunt, Morris, Edwards, and Wilson, 1993; Carr, LaBarge, Dunnigan, and Storandt, 1998).

2.4 Wellbeing checking framework advancement and models

A. Distant wellbeing observing framework

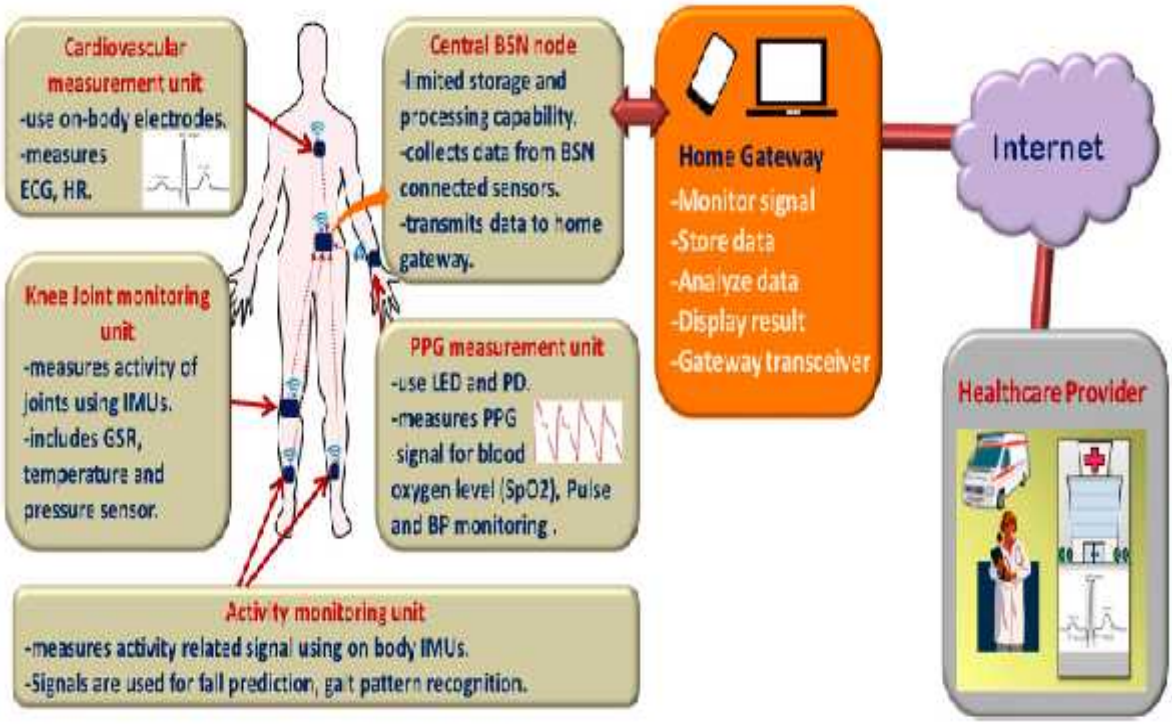


Figure 1. General overview of the remote health monitoring system.

*Figure 3 Remote health monitoring system (*Adopted from Sumit Majumder et al 2017

To be utilized for extended length checking, wearable flourishing seeing frameworks needs to fulfill certain clinical and ergonomic necessities. For instance, the framework should be lovely; the parts ought to be adaptable, insignificant in assessments and should be falsely slow, and nontoxic, hypo-allergenic to the human body.

Activity monitoring system

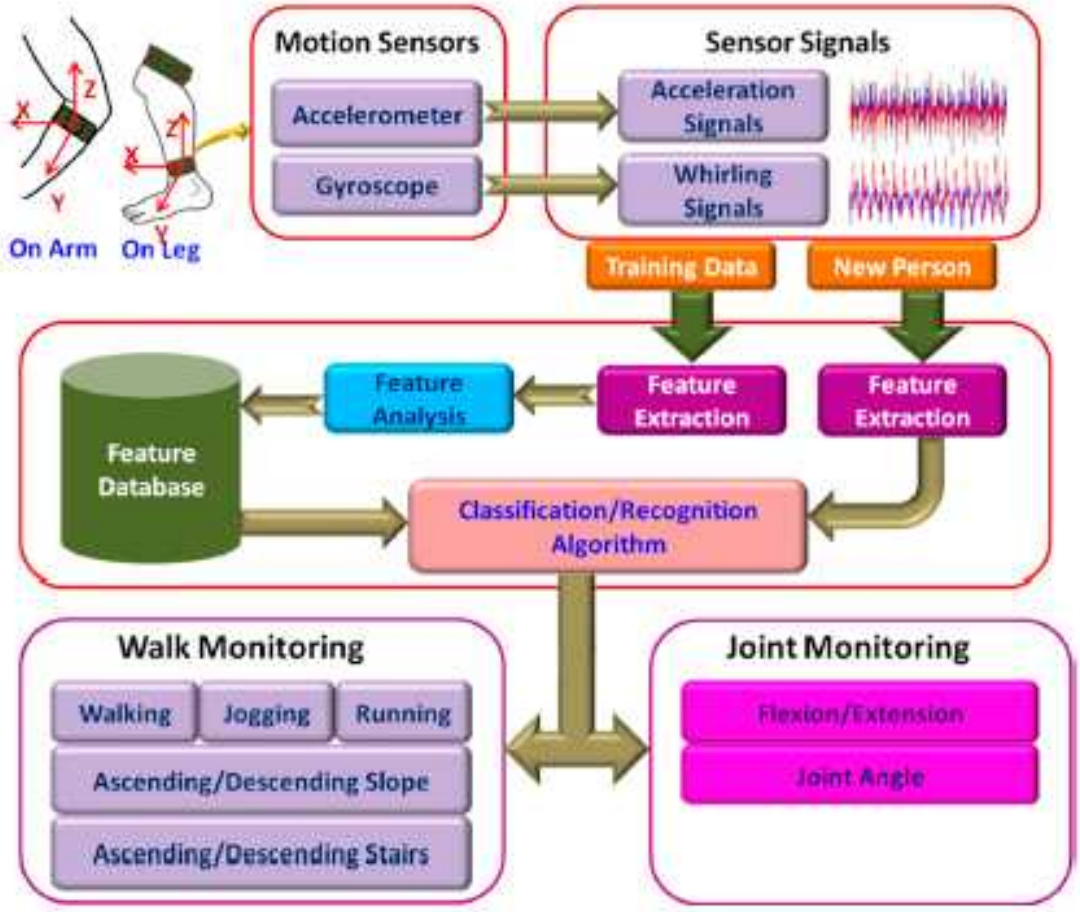


Figure 4. Schematic representation of activity monitoring systems.

*Figure 4 Activity Monitoring System (*Adopted from ***Sumit M et al,*** 2017)

Discussion

The standard occupation of this wearable flourishing seeing framework was to permit individuals to lead free and dynamic lives in their ordinary home climate while guaranteeing unsurprising, non-conspicuous, non-nosy, and consistent view of their thriving and certified achievement.

Consistent seeing of success status could give far reaching data about people's flourishing status all through some hazy stretch of time. The wearable sensors and actuators, gotten together with the overall data and trades movements opened the window to some other season of fiscally vigilant distant clinical thought associations. The frameworks were checking and information appraisal furthermore as sensible calculations, which may truly make the assumption for express diseases with a more authentic level of sureness, which lead to early examination and

treatment. In light of any potential clinical issue being perceived, the framework could raise an alert and tell people concerned or the clinical thought associations through secure far off media, for example, the web and the cell network with the target that fast clinical mediation could be started. Wire of speedy materials movements, for example, material based interconnections for sensors in wearable clinical advantages structures lead to more charming, non-meddling stages for thriving checking.

A Comprehensive Survey of Driving Monitoring and Assistance Systems

An all around arranged DMAS chipped away at the driving experience by continually checking the fundamental limits related with the driver, vehicle, and ecological factors by obtaining and setting up the data gained from various sensors.

The target of driving checking and help frameworks (DMAS) was to watch out for the driving status of a driver and to give fundamental help to protected and open to driving. Such frameworks help drivers by facilitating their control endeavors, building up their detecting power, cautioning them in the event of slip-up, etc. Contingent upon their functionalities, there were different names for such robotization frameworks, for example, canny vehicle control frameworks, progressed driver help frameworks, impact evasion frameworks, driver's absentmindedness observing frameworks, etc.

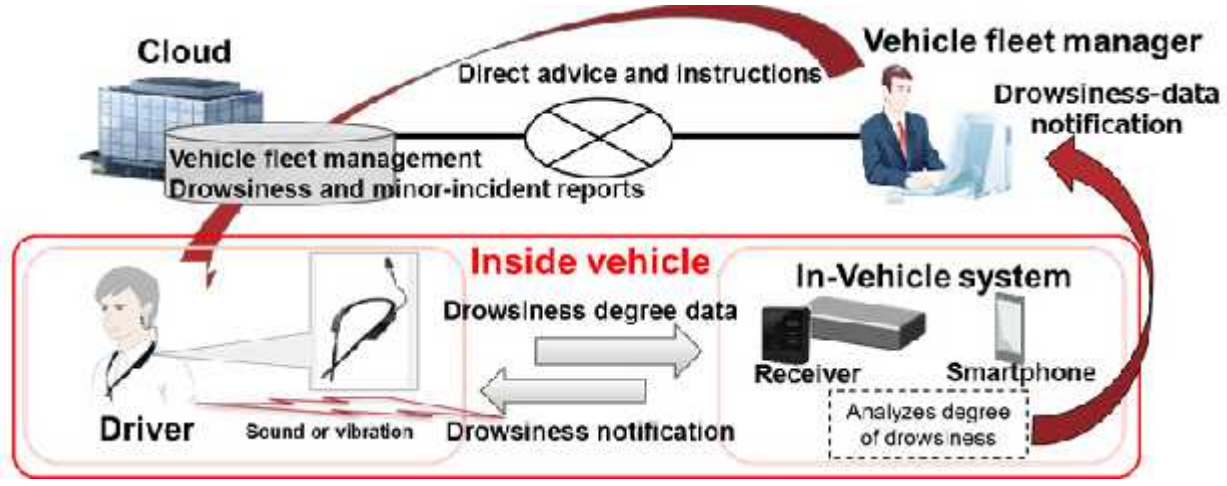


*Figure 5 DMAS Framework (Addopted from **Muhammad Qasim Khan et al 2019)***

DMAS in modern vehicles

Best in class models of present day vehicles are equipped with DMAS which help the driver in these activities, as shown in Table underneath. A short outline of composing and edge works

focused on aiding the drivers in secured and content with driving is presented under

Table 4. A summary of DMAS available in modern vehicles.

Company	Technology	Category	Monitoring System/Detection Parameters/Warning System	Important Features
Audi	Audi pre sense (driver assistance system)	Car-based	Far infrared system, Camera, Radar, Thermal camera/Lane position, Proximity detection/Audio, display, vibration	• Collision avoidance assist • Sunroof and windows closing • High beam assist • Turn assist • Rear cross-path assist • Exit assist (to warn door opening when a nearby car passes) • Traffic jam assist • Night vision
BMW	BMW Drive Assist (driver assistance system)	Car-based	Radar, Camera, Thermal camera/Lane position, Proximity detection/Audio, display, vibration	• Lane change warning • Night vision • Steering and lane control system for semi-automated driving • Crossroad warning • Assistive parking
Toyota	Toyota Safety Sense (Driver moniting system)	Driver-based	Radar, Charge-coupled camera/Eye tracking and head motion/Audio, display	• Advanced obstacle detection system • Pre-Collision System • Lane Departure Alert • Automatic High Beams • Dynamic Radar Cruise Control • Pedestrian Detection
Mercedez-Benz	Mercedez-Benz Pre-safe Technology (Attention assist)	Car-based	Radar, Camera, Sensors on the steering column/Steering wheel movement and speed/Audio, display	• Driver's profile and behaviour • Accident Investigation • Pre-Safe Brake and Distronic Plus Technology • Night View Assist Plus • Active Lane Keeping Assist and Active Blind Spot Monitoring • Adaptive High Beam Assist • Attention assist
Ford	Ford Safe and Smart (Driver alert control)	Car based	Radar, Camera, Steering sensom/Lane position, Proximity detection/Audio, display, vibration	• Lane-Keeping System • Adaptive cruise control • Forward collision warning with brake support • Front rain-sensing windshield wipers. • Auto high-beam headlamps

Table 1 DMAS in modern vehicles (Adopted from Muhammad et al 2019)

Discussion

The advantages of street transportation for individual and society are joined by unequivocal difficulties as life, property, and typical contamination. Here three head driver of driving misfortunes have been assembled, explicitly: impedance, weariness, and solid driving conduct. In this layout, the producers have investigated DMAS in a thorough manner by considering factors related with the driver, vehicle, and driving climate. From the conversation, the driver's consideration was the central portion for safe driving. Impedance and consumption are seen as the focal driver of street calamities.

The assessments revealed a few normal and physiological appraisals could precisely recognize a driver's psychological obligation. Also, the usage of present day depiction systems on the information acquired from the vehicle's instrumentation gave a decent degree of driving conduct. The affirmation of close by vehicles was likewise perceived as an immense portion of DMAS to stay away from any probably impacts. The assessment areas related with DMAS were emphatically interlinked which made it difficult to draw a reasonable cutoff between two regions. It had every one of the reserves of being that the models made for DMAS routinely thought to be a change band for drivers as they moved start with one state then onto the accompanying (e.g., from caution to tired). The best in class depiction frameworks subject to AI calculations showed huge in managing such conditions.

Similarly as upsetting a driver for all intents and purposes an oversight, the best in class DMAS moreover appeared to offer help at dynamic and development taking stages. In any case, it has every one of the reserves of being this framework didn't get mass get-together and it is now under research. Prior to the spread of such a framework, regardless, not just a sensible administrative consent should have been depicted, in any case immense evaluation was moreover required. The associated fundamental difficulties were quick and right choices by the machines which were for the most part settled on the machines' adjusting. The moving of human drivers' experience to machine insight was an enormous advancement in the field.

The attestation of such insightful and delicate frameworks by its end clients was not an immediate undertaking. This is considering the way that it required supportive suffering quality, security, and straightforwardness concerning free execution. Simultaneously, the game plan of easy to use ergonomic human-machine interface should have been set up. In any case, its producers recommended that these perspectives required a huge load of all around multidisciplinary research for a lot of a somewhat long timeframe.

Vehicular caution System Using mHealth information and lightweight security designs

The motivation driving the framework was to limit street mishaps by arranging the arising mHealth improvements with the vehicular data structure (VIS) utilizing far off body region network sensors and gadgets in a guaranteed and lightweight development. A combined secure framework worked with adoptability to give fortunate notice of crises to drivers to stay away from street episodes and make fitting coming about moves.

Incorporated Mhealth and vehicular data framework

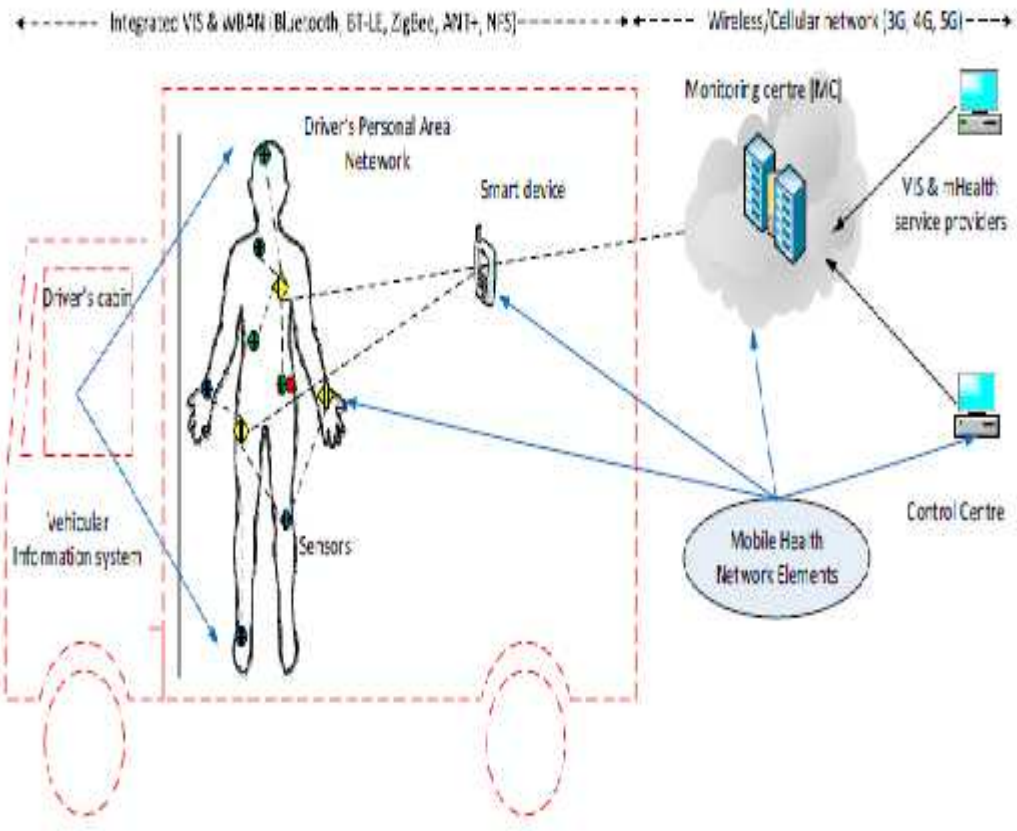


*Figure 6 Integrated mHealth and vehicular information system (Adopted from **James Jin Kang et al 2019)***

Integrated Vehicular Alarm System

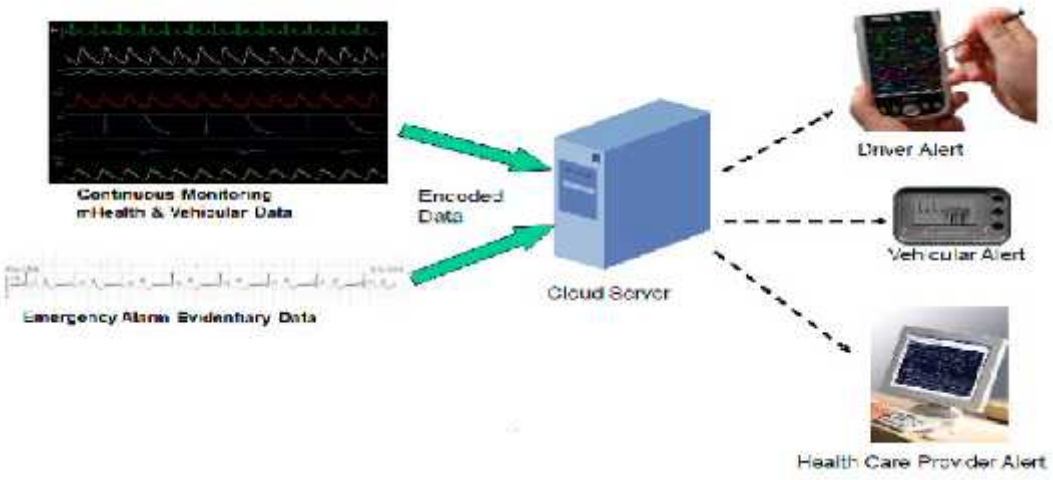


*Figure 7 Integrated Vehicular Alarm System (Adopted from **James Jin Kang et al 2019**)*

Discussion

This work brought a thought of a coordinated mHealth and VIS to foresee and advise alerts for significant distance drivers dependent on ongoing boundaries of the driver's ailment just as the street conditions. A trust-based security system was proposed to detect and safely communicate the driver's wellbeing information just as change vehicular and street conditions by means of a concentrated checking focus utilizing an original mix model. Aside from giving cautions ahead of time to the driver, the framework would likewise work with other significant gatherings like medical care suppliers and street help administrations to embrace a proper activity dependent on the ongoing keenly coordinated computational model.

The framework enjoys the benefit of a nonstop observing deduction framework for mHealth wearable gadgets and IoT vehicular sensors with a trust-based validation model to anticipate and send cautions precisely. The medical services suppliers, street transportation, and other applicable gatherings would utilize a particularly protected and wise alert framework to help the driver and the vehicle, without making any bother the street traffic framework. The framework was planned remembering the advances, interfacing guidelines, protection and security angles in the plan. It was the primary work done to propose for a vehicle wellbeing caution framework intended to join mHealth information of the driver and vehicular sensor information utilizing a lightweight security structure. The creators goes on to propose that future exploration should

deal with this multi-disciplinary issue of incorporating mHealth and VIS for further developing street security.

B. Smart in-Car wellbeing checking framework for old drivers in associated vehicle

The point here was to encourage a prosperity noticing system for old drivers using air cushion vehicle seat and embedded Internet of Things contraptions to recognize stroke starting during driving.

Continuous observing was utilized to distinguish stroke beginning during normal exercises like driving. Unusual physiological signs, face design produced during stroke beginning could be followed by ongoing checking utilizing sensors. Here, a structure of stroke beginning recognition utilizing sensors has been recommended and a framework appropriate for older drivers created.

It was discovered that whenever a wellbeing irregularity, for example, stroke was figured out continuously checking, framework would anticipate the sort and seriousness of stroke and propose potential advances. Framework could switch vehicle control to self-governing driving mode if accessible and move the vehicle to a protected spot. Framework could likewise create alert and send message with accessible data, for example, position to family members and crisis administrations to give crisis help so that affected driver can be moved to medical clinic/facility.

Discussion

This work gave data about a structure of Real-time in-vehicle wellbeing checking, for example, stroke location framework utilizing air pad and sensors for old drivers. To assess the affectability of grew older drivers' stroke location framework, test tests were led. From body pressure balance utilizing air pad, it was reasoned that the created vehicle seat was relied upon to recognize stroke in shifted lopsided postural position. Also, ECG/EEG, pulse sensor inserted in vehicle seat could screen and recognize irregularity when cerebrum stroke beginning occurred. In Overall, body pressure balance utilizing air pad, ECG, pulse information could distinguish unusual wellbeing status of older drivers' during driving. The makers recommended that future examination should consider an extent of bio-sensors and techniques.

Conclusions

From the health and driving monitoring models reviewed, the researcher choose to adopt the wearable devices to be used to capture and monitor driver's vitals, once the vitals have been captured they need to be analyzed to ensure they are within the normal levels. Incase of any spike or drop, an alert need to be communicated to the driver, suggesting necessary action to be taken to mitigate the same. Incase the driver responds promptly to the call then everything normalizes and the system goes back to the capture and monitoring mode. In case the driver fails to respond promptly, Framework should switch vehicle control to independent driving mode if accessible and move the vehicle to a protected spot. Framework ought to likewise produce alert and send message with accessible data like explicit area of the rate, subtleties of driver and the truck to family members, the momentary organization settle and crisis administrations to give crisis help so that influenced driver can be moved to clinic/center. From there the company management should take appropriate action to ensure the driver is well taken care of and if possible another driver is sent to take the cargo onboard to its destination.

However from the literature, most of the systems kept close monitoring of the surroundings as well as the condition of the vehicle itself i.e. some sensors were also installed to monitor the vehicle. For our case here the researcher is aimed at monitoring the health of the driver alone with no regard to the vehicle or its surroundings. This is because the researcher aims to ensure the system is of a low cost since integrating the other sensors would make it abit expensive.
The main aim of the DMAS was to ensure that the driver's driving was safe and comfortable. The researcher here aims to ensuring that the driver is in good and perfect health in order to enhance his driving performance. The researcher goes further and uses the health data captured for predictive analysis to ensure the driver is well informed to keep away from some terminal diseases like stroke and heart attack.

ADULT NORMAL VITAL SIGNS

Adult Vital Signs: Normal Ranges				
HR	**RR**	**SBP**	**DBP**	**Temp**
60–100	12–20	<120 mm Hg	<80 mm Hg	See below
Temporal artery			37.0°–38°C (98.6°–100.4°F)	
Tympanic temperature			37.0°–38.1°C (98.6°–100.6°F)	
Oral temperature			36.4°–37.6°C (97.6°–99.6°F)	
Rectal temperature			37.0°–38°C (98.6°–100.4°F)	
Axillary temperature			35.9°–37.0°C (96.6°–98.6°F)	

Factors Affecting Vital Signs				
Factor	**HR**	**RR**	**SBP**	**Temp**
Fever	↑	↑	Normal	↑
Anxiety	↑	↑	↑	Normal
Pain, acute	↑	↑	↑	Normal
Pain, chronic	↓	Normal	Normal	Normal
Acute MI	↓	↑	↓ (Late)	Normal
Spinal injury	↓	↓	↓	Normal/↑
Tamponade	↑	↑	↓	Normal
CHF	↑	↑	↑ (Early)	↑
Pulm. embolism	↑	↑	↓	↑
Exercise	↑	↑	↑	↑
↓ H&H	↑	↑	↓	↓
↓ Blood glucose	Normal/↑	Normal	Normal/↑	↓

Table 2 Adult Normal Vitals(Adopted from pinterest.com)

2.5 *Predictive Analytics?*

The articulation "Prescient examination" depicts a methodology of getting an information into the possible future events subject to the open data and quantifiable examination, reacting to the request "What might happen?"

Prescient examination can be depicted as a piece of state of the art examination that is utilized in the making of conjectures about dark future events or activities that lead to decisions.

Prescient examination relies upon reasoning that is drawn from hypotheses made by individuals to fit a hypothesis (oversaw learning). A lot of rules and cycles are framed into a formula that endeavors assessments and is known as a computation. Predictive analysis can likewise be founded on solo realizing which doesn't have a directing speculation and utilizations a calculation to look for examples and design in information and bunch them into gatherings or bits of knowledge. In solo learning the machine may not realize what it's searching for however as it measures the information it begins to distinguish complex cycles and examples that a human may never have recognized and thusly can enhance analysts searching for something new. Both regulated and solo prescient demonstrating are substantial scientific devices to use in a balanced utilization of these advances

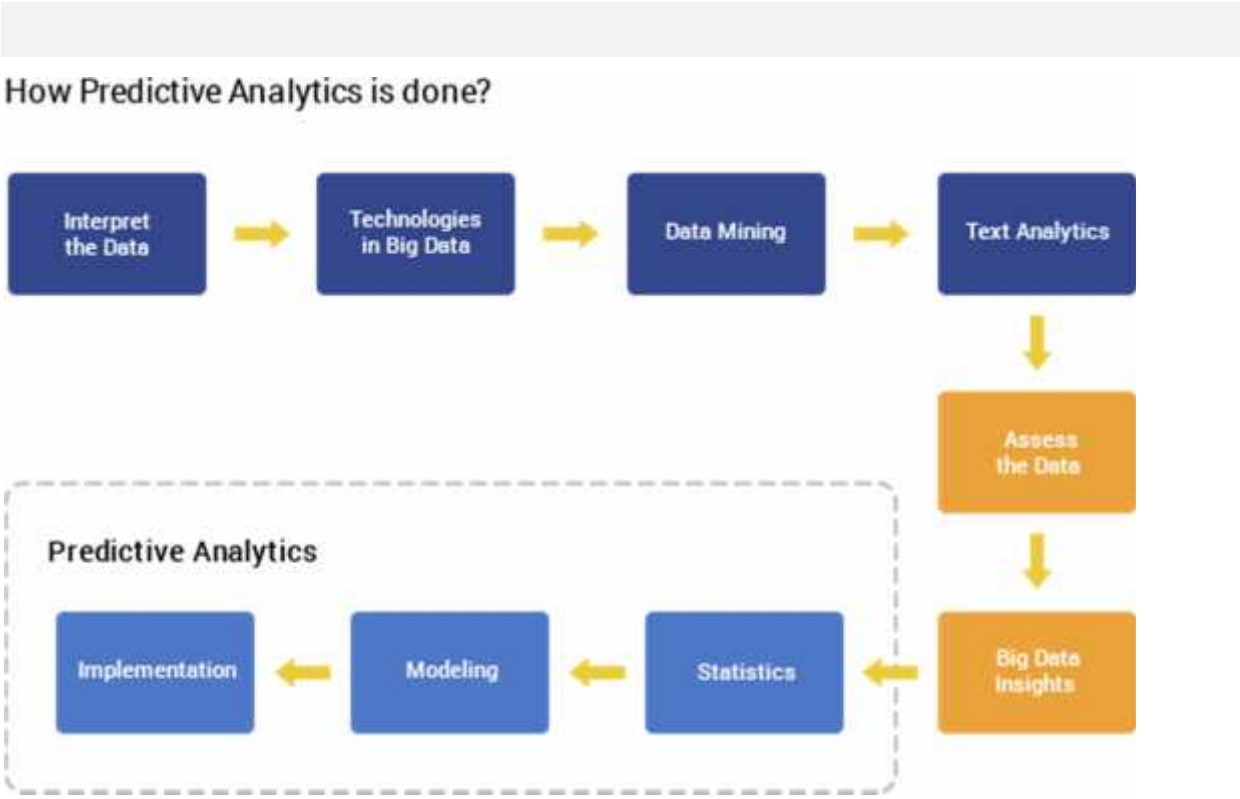


*Figure 8 Predictive Analysis Process (*Adopted from Deloitte analysis)

Risk Matrix Window

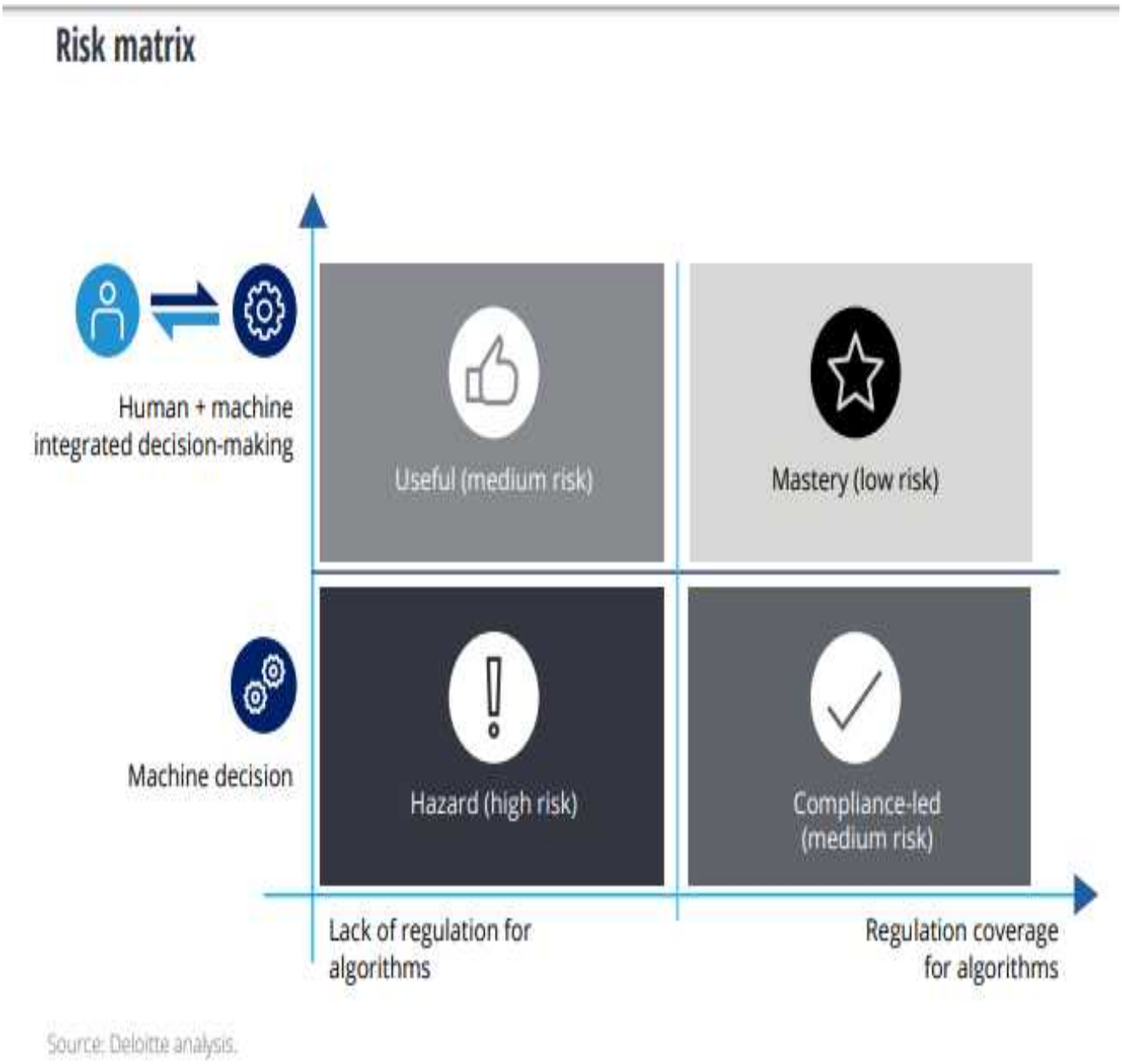


*Figure 9 Risk Analysis Window (*Adopted from Deloitte analysis)

A clinical dynamic instrument for setting mindful and patient-explicit far off observing frameworks utilizing the relationships of different essential signs

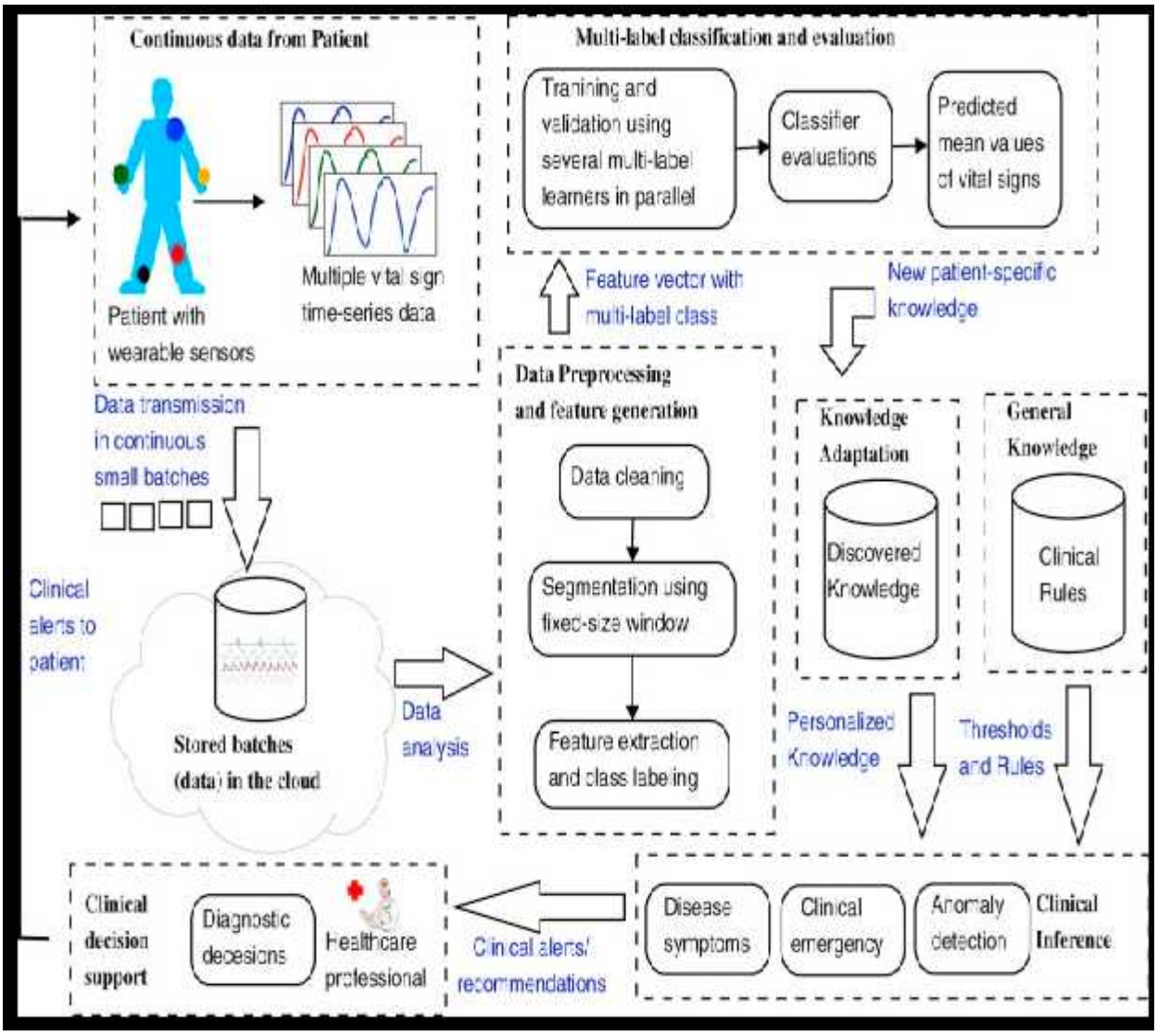


*Figure 10 Clinical Decision-Making (Adopted from **Jingkun Chang et al 2017**)*

2.6 SYSTEM ARCHITECTURE

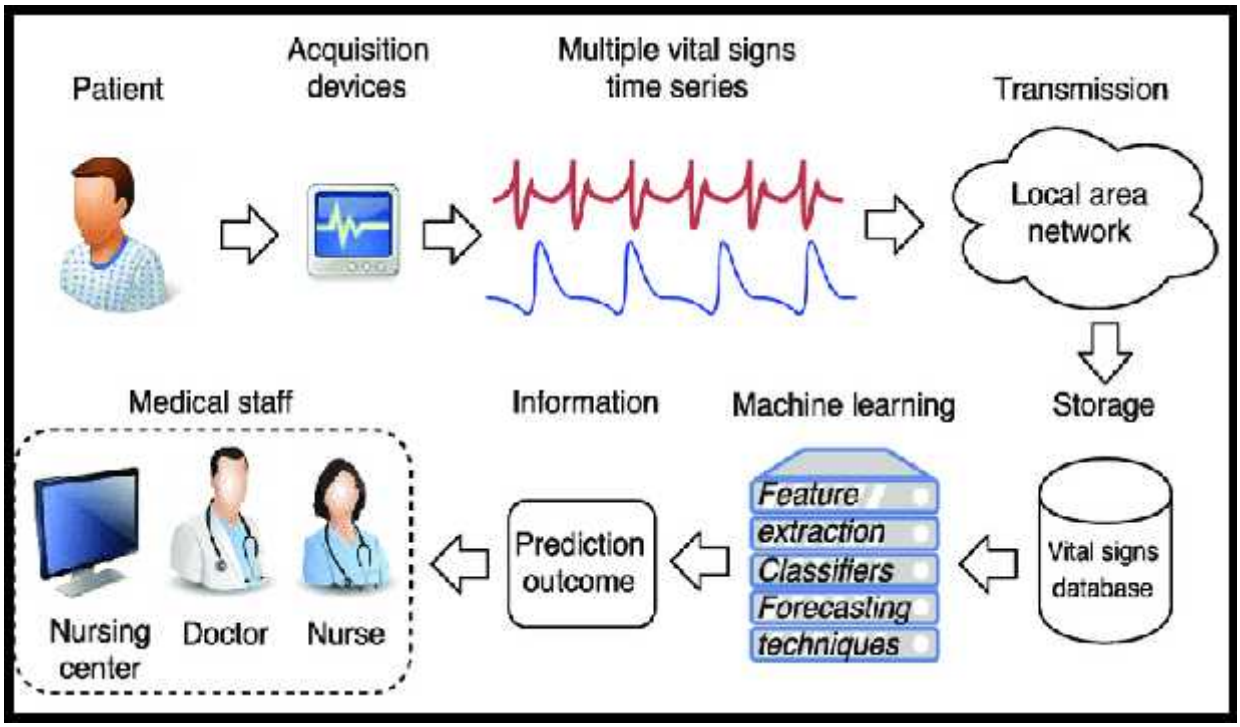
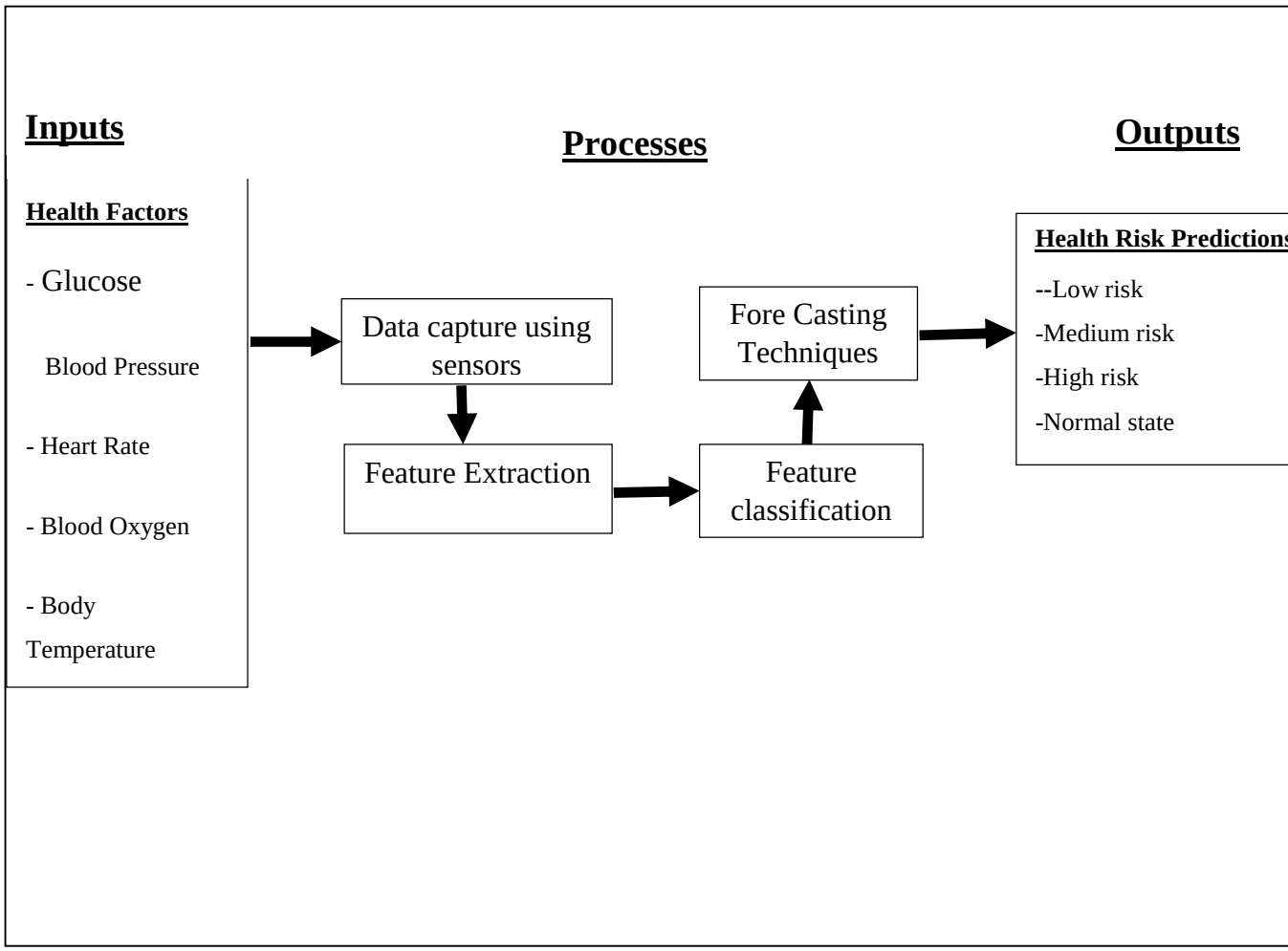


Figure 11System architecture(Adopted from JOSUÉ REYES-GARCÍA et al 2018)

2.7 Conceptual Model



2.8

Figure 12 Conceptual Model

2.9 RESEARCH GAPS

In any case, ongoing examinations have not given a far reaching and direct strategy for dealing with the driver's wellbeing, just as offering the suitable types of assistance for safe driving. Hence, the medical care administration framework that can screen different indispensable signs through different sensors during driving and give proper notice, suggestions, and surprisingly conceivable disconnected crisis administrations is exceptionally attractive for transporters or drivers experiencing persistent illnesses. By exploiting the detecting foundation and innovations given by brilliant urban areas, more wise wellbeing administrations can be accomplished to arrange existing assets (data or administrations) to fulfill the customized

necessities of the drivers as indicated by the investigation of continuous tangible information, which can be considered as shrewd wellbeing (s-Health) (Solanas et al (2014)..

Further, Greenfield et al(2016) raised that evaluation should separate the effect and experience of utilizing wearable gadgets, and to get a handle on the effect of thriving seeing on driving execution and security, and drivers' success and prospering.

3 CHAPTER THREE: RESEARCH METHODOLOGY

This examination work had three parts that contain:

• Information gathering on the insights around wellbeing components to be checked utilizing wearable sensors among significant distance transporters and its impact on the driving execution among these drivers.

• Design and improvement of a model

• Testing of the model – this empowered us test how drivers' wellbeing could be observed to improve their presentation.

3.1 Data Collection

This exploration study depends on data assembled on the wellbeing variables to be observed utilizing the wearable sensors among significant distance transporters and its impacts on their driving exhibition. The utilization of innovation for this situation alludes to the utilization of wearables to screen their wellbeing.

No comparable examinations have been done in Kenya, and consequently both exploratory and check approaches will be utilized for this examination determined to figure the theory that ICT can be utilized to screen wellbeing among significant distance transporters to improve their presentation. A logical way to deal with research which includes a blend of the subjective, quantitative and the participatory exploration strategies will be utilized to confirm the theory that ICT can be utilized to screen wellbeing among significant distance transporters to improve their presentation.

A primer report, the view of significant distance transporters' way of life, was directed to help the plan of the exploration issue explanation and examination questions. The investigation applied a blend of both the subjective and subjective exploration techniques and the examination system utilized was the review strategy for which a blend of information assortment strategies (Creswell, 2002) was used.

3.2 Study area and Sampling

3.2.1 Study area

The goal of this exploration was to thought of an answer that will guarantee the wellbeing of significant distance transporters is all around checked to work on their exhibition. For The starter study

All transporters driving between Mombasa International Port and Kisumu Dry Port were the source populace. Drivers who had no less than one-year experience were remembered for the investigation to acquire the base openness time. In any case, drivers over 60 years old were barred to control age-related impact and the individuals who had a background marked by mishap from a referred to cause, for example, auto accident and were additionally rejected since they are in danger of creating medical problems from the injury.

3.2.2 Subset

An example is a subset of a populace or just the quantity of things to be chosen from the populace. The equation ways to deal with deciding the example size. The example size for transporters was determined utilizing Yamane‟s equation. $n=N/1+N(e)^2$

That is:

n = the example size (100 transporters)

N = the populace size

e = the degree of exactness

$n=100/(1+100(0.07)^2) = 67.1$

Test size for primer investigation is 68 transporters.

3.3 Data Acquisition and Collection

The accompanying information obtaining and assortment techniques were utilized for the assortment of information for the fundamental examination directed on the impression of transporters' way of life. A few strategies were likewise utilized during model testing.

3.3.1 Interviews

Two unique meetings have effectively been directed:

• Interviews at Freight Forwarders and Logistics public office in Kenya to get what constructions and frameworks the association at present has set up, how they work, how powerful they have been in observing their representatives' wellbeing (these are the triumphs and disappointments of the current frameworks) and what likely arrangements they have.

• The Kenyan populace, that is, the transporters, the individuals who have been defenseless against medical issue because of their functioning conditions and way of life. What has been their experience and what are their assumptions and their considerations and perspectives on the utilization of innovation to work on their wellbeing to improve their presentation.

Vis-à-vis interviews were directed in the two cases with people who addressed the two gatherings. These meetings were utilized to build up what issues the transitory organization and individual transporters were confronting.

3.3.2 Questionnaires

For the starter study, shut and open finished poll questions were utilized to decide transporters' insight on their way of life and weakness of their wellbeing. The examination caught the information, disposition and practice of significant distance transporters.

For the model testing phase of this task, polls and meetings were utilized in a study on the utilization of wearables to screen transporters' wellbeing to upgrade their exhibition.

3.3.3 Focus Group Discussions

Center gatherings are little gathering conversations, tending to a particular subject, for this situation the point being significant distance truck driving. FDGs were utilized to commend the poll in the view of truck driving investigation. The essential justification utilizing FDGs was to accumulate subjective data that is past the extent of quantitative data assembled utilizing the polls.

The FDGs were done in the two transitory organizations including administrators and representatives working in these organizations where more subjective data on the transporters'

presentation markers could be gathered. The conversations zeroed in on the utilization of innovation to screen transporters' wellbeing and accordingly improve their presentation.

3.3.4 Document Review

Study and audit of material from past investigations and tasks done in different nations on innovation use in truck driving is of significance since comparative examinations are yet to be done in Kenya. This strategy was utilized to decide the different wellbeing factors adding to the terrible showing in truck driving and distinguish a portion of the presentation pointers. Information gathered utilizing this technique was utilized to conjecture how these elements could be observed and controlled to upgrade their exhibition. This included investigating existing data found on distributed writing and diaries.

3.3.5 Data Collection Procedure

The scientist acquired a moral freedom license from the pertinent foundations to permit him visit the designated establishments. The information was gathered from the supervisors from the inspected transient organizations through surveys. The scientist took the information assortment instrument to them the day he had booked a meeting with them subsequent to having looked for consent from applicable experts in similar passing organizations. Following the meeting plan, the meetings with the drivers were directed too.

3.3.6 Information investigation and translation

The information ganered from both the fundamental and the model testing was both quantitative and subjective and a measurable examination utilizing Factual bundle for sociologies especially the SPSS was performed. Aftereffects of the primer investigation were examined and lead to the definition of the exploration goals and questions. For the subjective examination, the content information got through the meetings, polls, perceptions and records explored was coded and dissected for topics to empower investigation utilizing SPSS. Information that was gathered utilizing model was utilized in prescient investigation to educate the drivers regarding their ailments.

3.3.7 Ethical Considerations

Prior to leading the investigation on the view of truck driving, the respondents were educated regarding what the examination project was about, its exploration objectives and goals and they gave their assent prior to filling in the surveys, addressing inquiries questions and participating

in bunch conversations. All respondents were ensured classification since they didn't distinguish themselves utilizing their names on the surveys.

Information gathered utilizing the model was imparted to the transporters to empower them know how they were doing wellbeing savvy.

Summary of Methodology used to achieve the objectives	
Research Objectives	
To identify health factors to be monitored using wearable sensors among long distance truck drivers	Survey (Interviews, Questionnaires, Focus Group Discussions)
To evaluate how the health factors affect the driving performance among long distance truck drivers	Overview (Interviews, Questionnaires, Focus Group Discussions, Empathy), Document Review
System Objectives	
To create and develop an integrated health monitoring wearable to monitor the health of long distance truck drivers	Fast Application Development strategies to concoct a model of the wellbeing checking gadget
To design and implement predictive analysis model on data captured from the long distance truck drivers	Use of the prototype to monitor drivers vitals and later process the data through predictive analysis to caution them about their health.

Figure 13 Methodology summary

4 CHAPTER FOUR: SYSTEM ANALYSIS AND DESIGN

4.1 Preliminary Study

The scientist worked with both subjective and quantitative information. Subjective information was gathered from transporters who were occupied with talk with meetings. During the interviews they gave their views on the challenges they encountered on daily basis, how they dealt with the challenges and which health issues they felt should be addressed.

Quantitative data was collected from questionnaires prepared and distributed to truck drivers physically and remotely where they gave their views as well.

4.1.1 Results and Findings

4.1.1.1 Qualitative data

The drivers were 40 ± 5 years of age all round, and had been in the calling for quite some time. Every one of them were male, and the vast majority of them drove significant distance hefty products vehicles.

The researcher identified three themes from the drivers' narratives. The themes refer to challenges drivers experienced while on transit, how they addressed the challenges and what health issues the wearable devices should address.

Major challenges while on transit

The first theme relates to the challenges the drivers were experiencing while on their transit. Most of the drivers acknowledged that their life was full of challenges like pressure from their bosses due to late delivery of goods.

Many of them mentioned they suffered hypertension as a result of stress and demands from their employers and members of their families. Others endured drowsiness while on the authentic since don't rest the measure of required hours prior to beginning their shift.Some talked of poor diet since the only food they could access was just a snack coffee and bread, and if luck was on your side ugali and nyama. Others suffered insecurity especially after the dusk, where they lost their valuables like phones, money and even their clothes and shoes. Some blamed traffic jam and mechanical problems to their late delivery of goods. Here are some of their verbatim.

"Most of us here are suffering high blood pressure. This our job has a lot of pressure and stress. From our employers who will always expect you to deliver cargo within the scheduled

time despite the aspect of traffic jams on the road. Family members expect you to join them over weekends which has become impractical due to job demands."

"We really sleep well, we only rest for 3 to 4 hours daily which very little in relation to the work we do which require a lot of concentration."

"Huku chakula unakula kile umepata: ukipata kahawa na mkate unakula, ukibahatika kupata ugali na nyama pia sawa. La sivyo unajipikia mwenyewe kwa gari ambapo pia chakula hicho hicho ndicho rahisi kupika, sanasana chai na mkate."

"Security is also a major challenge on our part. Last month I was a victim. As I approached a certain hill and with the pot holes on the road I had to slow down, little did I know it was a dangerous move. Some people came from the roadside and cut off my air pipes(those that supply air from the cooling system to the tyles) the next thing I noticed was that my wheels could no longer move thus leading to my truck slowing down and stopping. Immediately two people came and stood at my door demanding for my phone, money and shoes. I had no option but to oblige."

How they dealt with the challenges

Following the discussion on the challenges they faced while on transit, we discussed the various ways through which they addressed the above mentioned challenges. Those experiencing hypertension mentioned that they would carry with them a number of jericans with clean water to keep themselves hydrated as this would mitigate the high blood pressure. Others pointed out that they had some prescribed medicine from their doctors which they would take some hours before and after the journey.

The group experiencing sleepiness pointed out that they had devised mechanism to mitigate the same like chewing khat and washing their face with cold water any time they felt like dosing off.

Those with feeding problems pointed out that they normally buy take away foods from hotels before they start off the journey.

For the security some said insurance cover had been taken to cover the goods against theft though there was no cover upon them. Another one said that since the time he had the theft incidence he does not drive beyond 6:45pm. Here are some of their verbatim.

"For me hypertension is a big challenge. I always ensure I have a 20litre drinking water everytime. Anytime I feel unwell I normally take one and half litres of water and I feel good. I already know that water is such a remedy."

"Kwangu nikisikia kulala hunawa uso na maji baridi inaishi. Wakati mwingine huwa nanunua mirra na kutafuna kidogo kidogo. Hivyo basi siwezi patwa na usingizi."

"To curb hunger I normally buy food from hotels or restaurants before departure and carry it with me since I don't get time to park and feed from a hotel"

"For insecurity issues, the company has already insured the goods while on transit. However we don't have insurance cover on the drivers which is so sad."

"For me I have vowed never to be found on the road beyond 6:45pm, this is for my own security and to have good rest"

Issues to be addressed by the smart wearable devices

When asked what they would want monitored by the device: most of them were like "don't track us, are you sure it is not a tracking device" others feared that I wanted to check their Covid 19 status which they were not ready for.

Another respondent felt that this gadget should monitor our blood pressure which is our biggest threat here. He argued that their working environment was the greatest cause to the pressure. Their employers are always on their necks incase they delayed delivery of goods. Yet they fail to put into account the challenges on our road like traffic police, jam.

Some felt that this gadget should not only monitor our pressure but administer an injection once they found it to be high.

Others were so bitter that the "truck drivers" have become the laughing stock to the society. Every time a disease comes up, the government always blames them of spreading the same, i.e HIV, and now Covid. They didn't understand why it was so yet they are also human and fathers to children like any other Kenyan.

Others felt that the wearable device should monitor their body temperature, to avoid the harassment they were getting at the border. They argued that with this device their temperature

would be continually monitored and incase it raises a red alert should be sent to the driver, nearby health facility and the fleeting company headquarter. So instead of going through the testing process, they can go straight to seek medication. Some of their verbatim were as follows:

"Don't track us, we are tired of these tracking devices"

"Hata wewe umekuja kutupima covid harafu tukipatikana mnatuweka quarantine, sisi hatuna pesa rudi ulikotoka"

"Our main challenge here is blood pressure. Most of us here are suffering from hypertension as a result of this kind of our job. We have stress from every corner: our government, our employers and our families. "

"If only that gadget could monitor our pressure throughout and incase it goes high to administer an injection automatically without our knowledge. Hii kitu imetusumbua sana. Hatuna pesa ya kununua madawa yake"

For me am very bitter with the government: how comes we are always to blame of the spread of every disease that comes in kenya. Kwanza ilikuwa HIV sasa ni Covid 19. Kwani sisi sio watu kamw wengine. Mjue sisi pia ni mababa kama wale wanaume wengine"

"I wish this gadget could track and monitor our temperature. This would enable us avoid the kind of harassment we normally get at the border. Incase an increase in temperature is noted the driver should be alerted via mobile phone and a similar alert should be sent to the company headquarter and a nearby medical facility. Instead of having to queue awaiting testing this particular can go directly to the facility to get treatment"

4.1.1.2 Quantitative data

An example was haphazardly chosen and a sum of 20 respondents participated in the study. It comprised of 20 truck drivers from 3 fleeting companies within Nairobi County namely Bollore transport and Logistic, Signode and Kopa.

Demographic characteristics

Variable	Attribute	Respondents	% of respondents
Gender	Male	16	80%
	Female	4	20%
Duration of service	Less than 5 years	4	20%
	6 to 10 years	6	30%
	11 to 15 years	7	35%
	16 to 20 years	2	10%
	Above 20 years	1	5%

Table 3 Demographic Characteristics

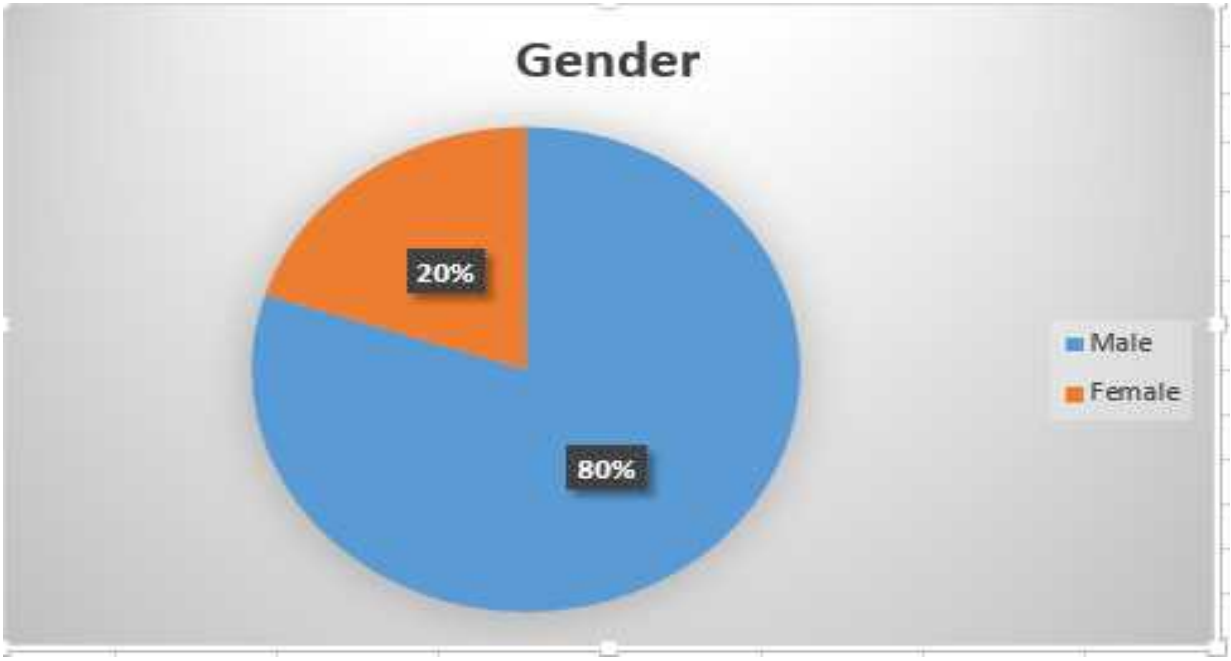


Figure 14 Gender

The study aimed at finding the gender of the respondents

80% were male while 20% were female.

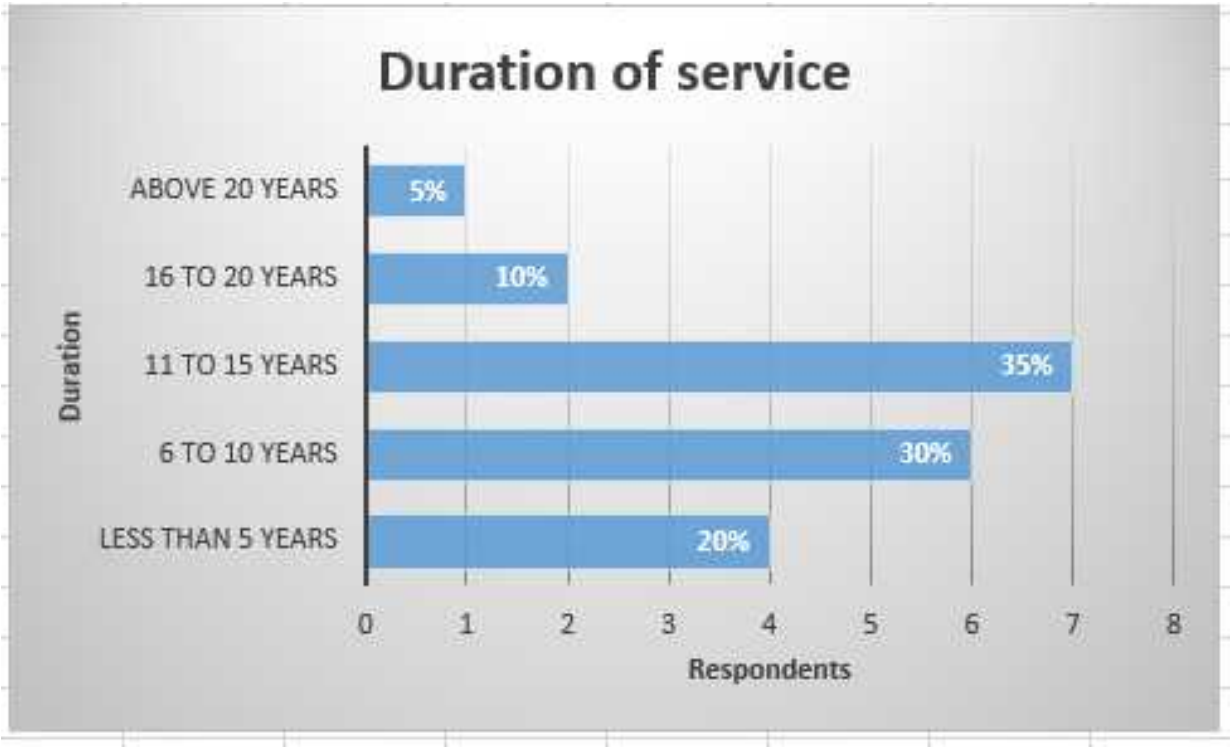


Figure 15 Duration of service

The study aimed at finding out the number of years had the respondent served as a truck driver

35% of them had served for 11 to 15 years 30% 6 to 10 years, 20% had served for less than 5 years, 10% 16 to 20 years and only 5% above 20years.

Awareness about the wearable devices

	Heard of wearable devices	No idea on wearable
Truck driver	13 65%	7 35%

Table 4 Awareness on Wearable devices

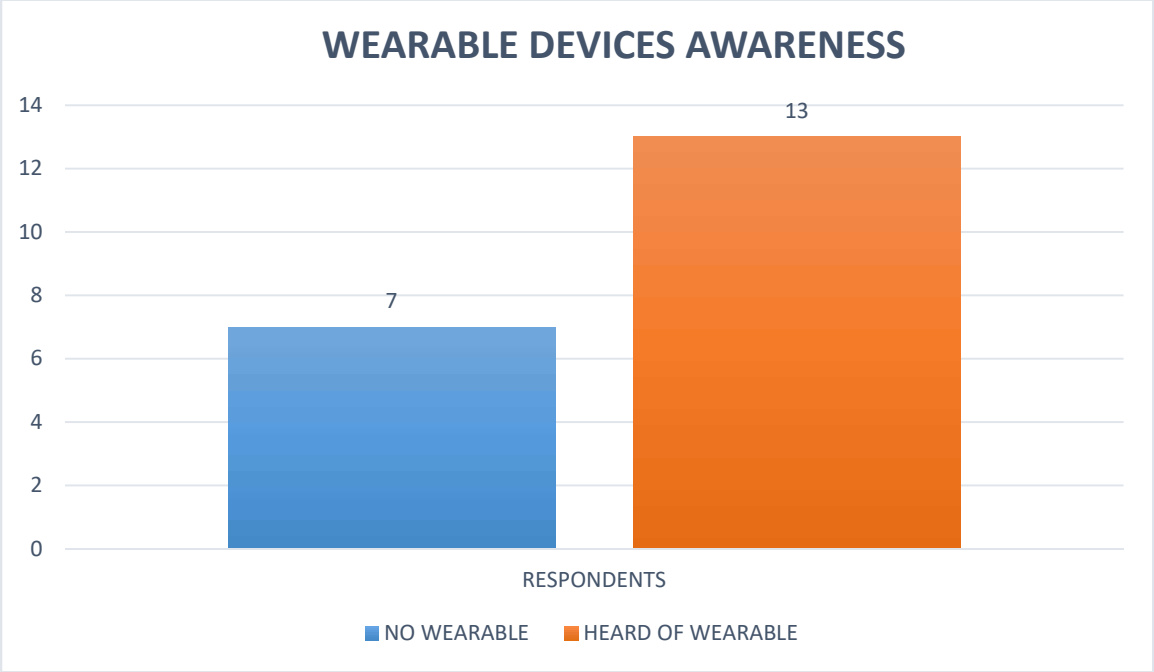


Figure 16 Wearable device awareness

The study aimed at finding out the respondents who had heard about wearable devices before

65% had heard about them while 35% had not yet heard about them

Accident cases

Case of an accident	No accident case
13 65%	7 35%

Table 5 Accident Cases

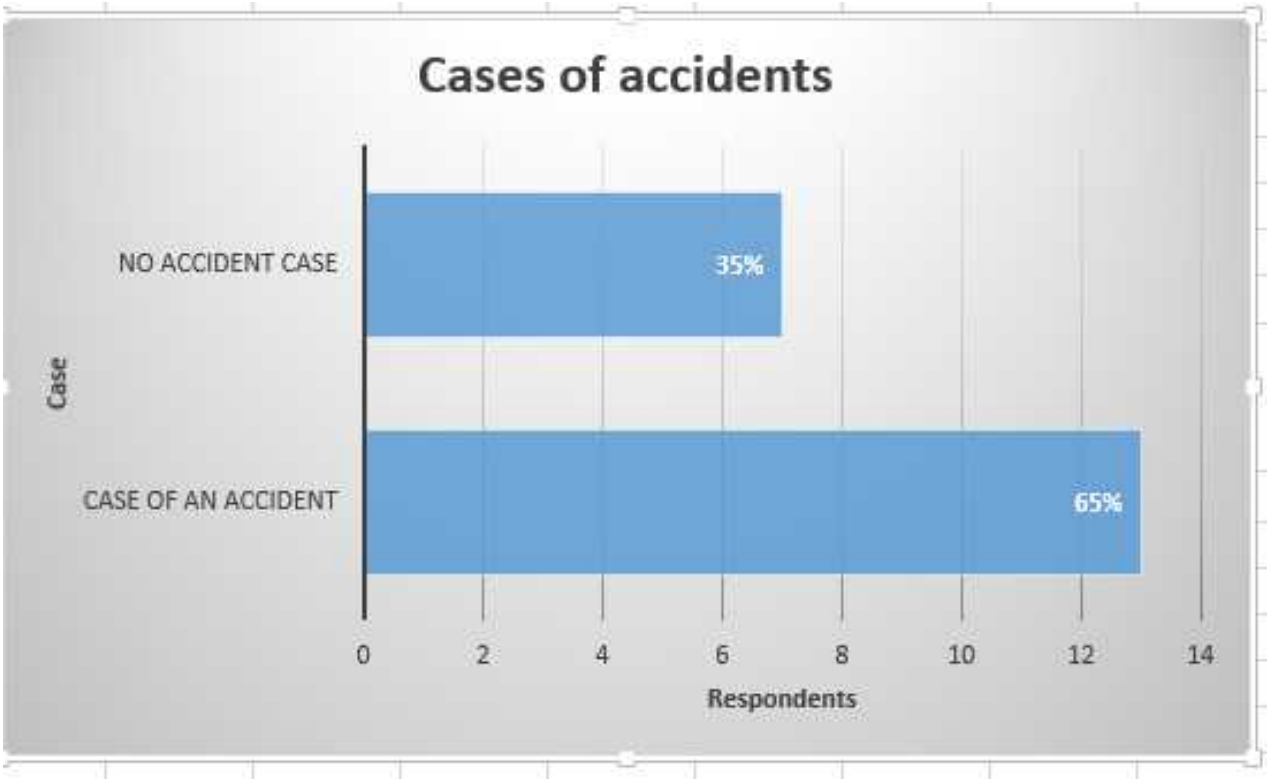


Figure 17 Accident Cases

The study aimed at finding out the number of accident cases while on transit

65% had an accident while 35% had no accident.

Causes of the accidents

Accident Cause	Total respondents	% respondents
Sleepiness	10	50%
Road unworthiness	1	5%
Tiredness	9	45%
Blurred vision	4	20%
Vehicle breakdown	1	5%
Drowsiness	2	10%
Bad weather	5	25%
Other	4	20%

Table 6 Accident causes

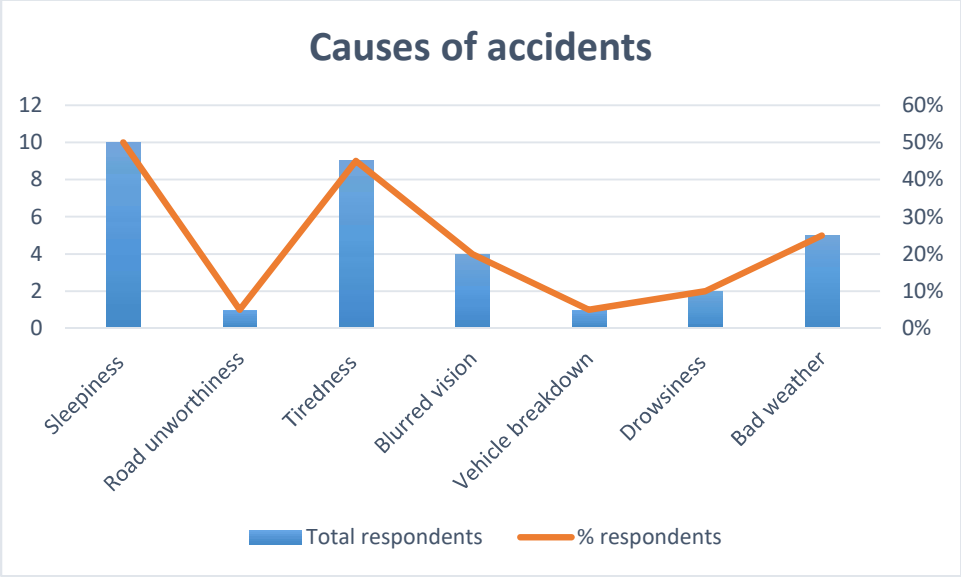


Figure 18 Accident Causes

The study aimed at finding out the major causes of the accidents

50% claimed that sleepiness was the major cause, 45% tiredness 25% blamed bad weather, 20% suffered blurred vision which lead to the accident, 10% attributed drowsiness to the accidents while 5% blamed vehicle breakdown.

Likelihood of being a major health challenge

SAMPLE SIZE = 20

	Definitely	Probably	Possibly	Possibly Not	Definitely Not
Back pain	10 50%	7 35%	1 5%	1 5%	1 5%
Sleeping apnea	15 75%	2 10%	1 5%	1 5%	1 5%
Dementia	2 10%	4 20%	1 5%	10 50%	3 15%
Diabetes	7 35%	3 15%	2 10%	4 20%	4 20%
Hypertension	15 75%	3 15%	2 10%	0	0
Obesity	5 25%	2 10%	5 25%	4 20%	4 20%
Poor vision	9 45%	6 30%	1 5%	3 15%	1 5%
Stroke	2 10%	1 5%	2 10%	8 40%	7 35%
Depression	7 35%	6 30%	2 10%	3 15%	2 10%

Table 7 Likelihood of a condition

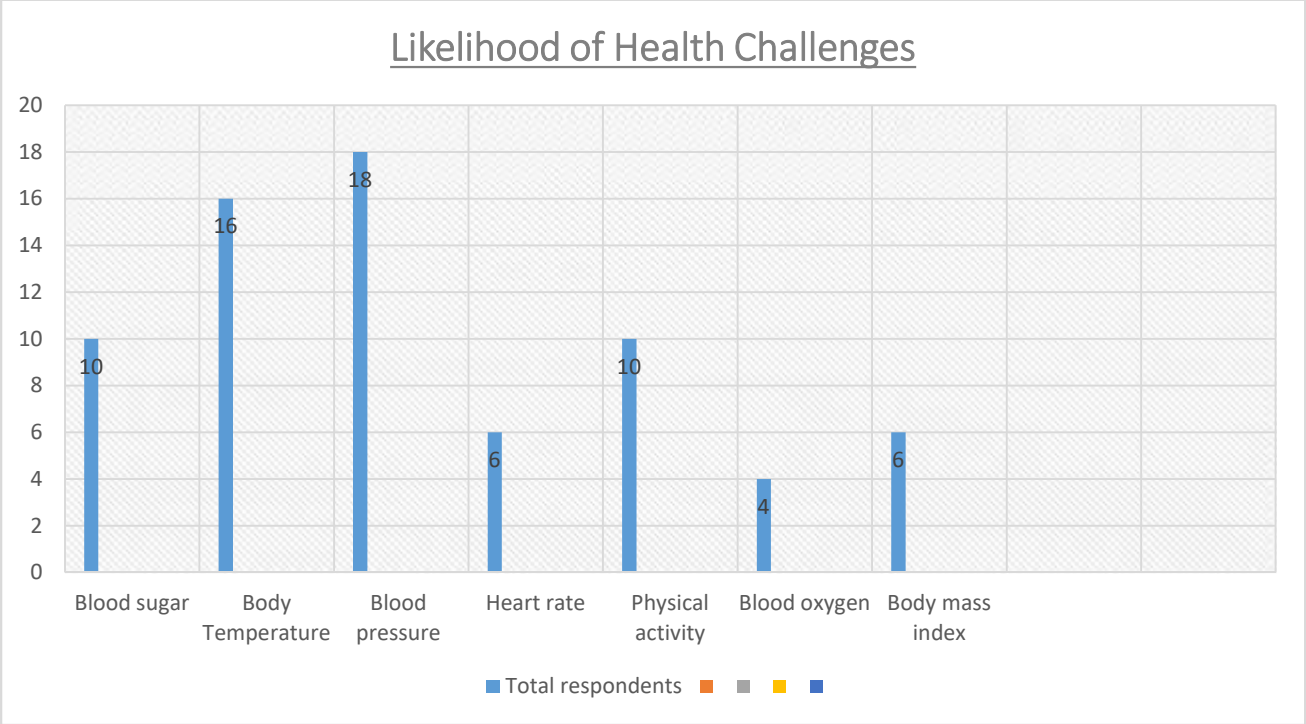


Figure 19 Likelihood of being major health challenge

The study aimed at finding out the likelihood of being major health challenge to the driver

75% sleeping apnea, 75% hypertension, 50%backpain, 45% poor vision, 35% depression, 35% diabetes, 25% obesity, 10% dementia and 10% stroke.

Discussion

- Most of the respondents were male.
- The highest number of respondents had served for 11 to 15 years.
- A good number of the respondents were aware of wearable devices.
- The highest number of respondents reported accident cases which were as a result of
    - Sleepiness
    - Tiredness
    - Blurred vision
    - Bad weather
    - Drowsiness
- Most of the respondents recommended monitoring of blood pressure and body temperature.
- Sleeping apnea and hypertension were voted as the major health challenges among the respondents.

This brings out gaps/opportunities for the implementation of wearable technology

Issue /Aspect	**Gap / opportunity**	**Design Implementation**
Most of drivers using smart phone	Smart phone usage	Opportunity to use ICT (Relay feedback via SMS)
Already aware of wearable devices	Awareness	Opportunity to use ICT (Wearables usage)
High number of accidents reported	Mitigation practices awareness	Opportunity to use ICT (Control system)
Sleepiness and tiredness the main cause of accident	Control / prevention awareness	Opportunity to use ICT (Control system)
Blood pressure and body temperature require monitoring	Monitoring devices	Opportunity to use ICT (Monitoring system)
Sleeping apnea and hypertension the main challenge	Control awareness	Opportunity to use ICT (Monitoring system)

Table 8 Gaps / Opportunities

4.2 System Design

4.2.1 The Prototype

The principle objective of this examination project was to contemplate and break down the wellbeing elements to be checked utilizing wearable sensors among significant distance transporters, its consequences for their driving presentation and foster a model to assess something very similar. For the advancement of the model, the favored technique is the Rapid Application Development (RAD).The primary objective of this examination project was to consider and investigate the wellbeing variables to be observed utilizing wearable sensors among significant distance transporters, its consequences for their driving presentation and foster a model to assess something very similar. For the advancement of the model, the favored procedure is the RAD.

4.2.1.1 Quick Application Development

QAD Is an improvement lifecycle intended to give a lot quicker turn of events and better caliber those accomplished with the customary programming advancement lifecycle. Basics of this system are:

• Social occasion essentials using studios or focus get-togethers

• Prototyping and early, reiterative customer testing of plans

• The re-usage of programming sections

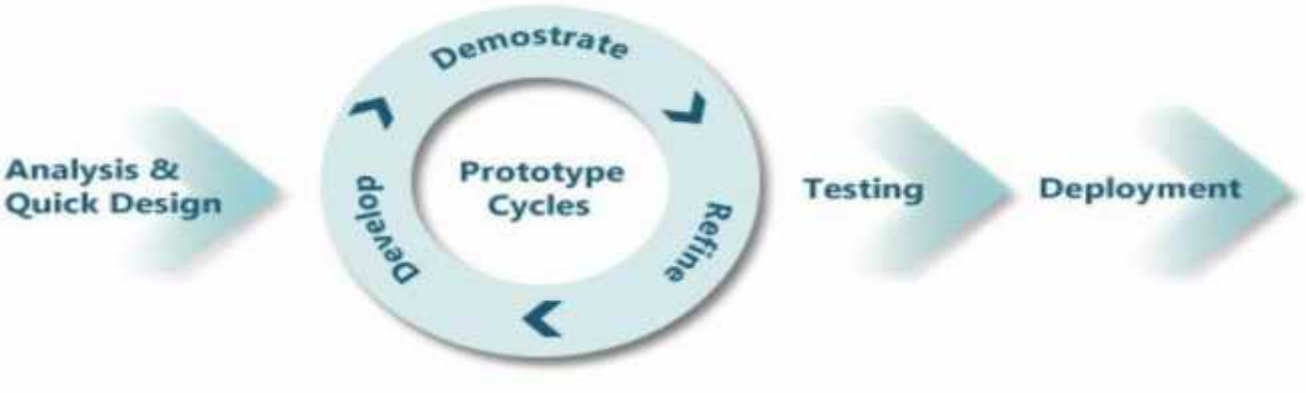


Figure 20 : Rapid Application Development Model (source: ramsoft.com.au)

4.2.1.1.1 Stages of Rapid Application Development

• Investigation and fast plan: This includes necessities arranging and model plan

• Prototype Cycles: This stage is iterative and is the place where genuine structure of the product framework happens. A model is created and exhibited to the client after which it refined

• Testing and Deployment: Is the place where by the total model is tried and is prepared for use.

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Typical Layout of DMAS

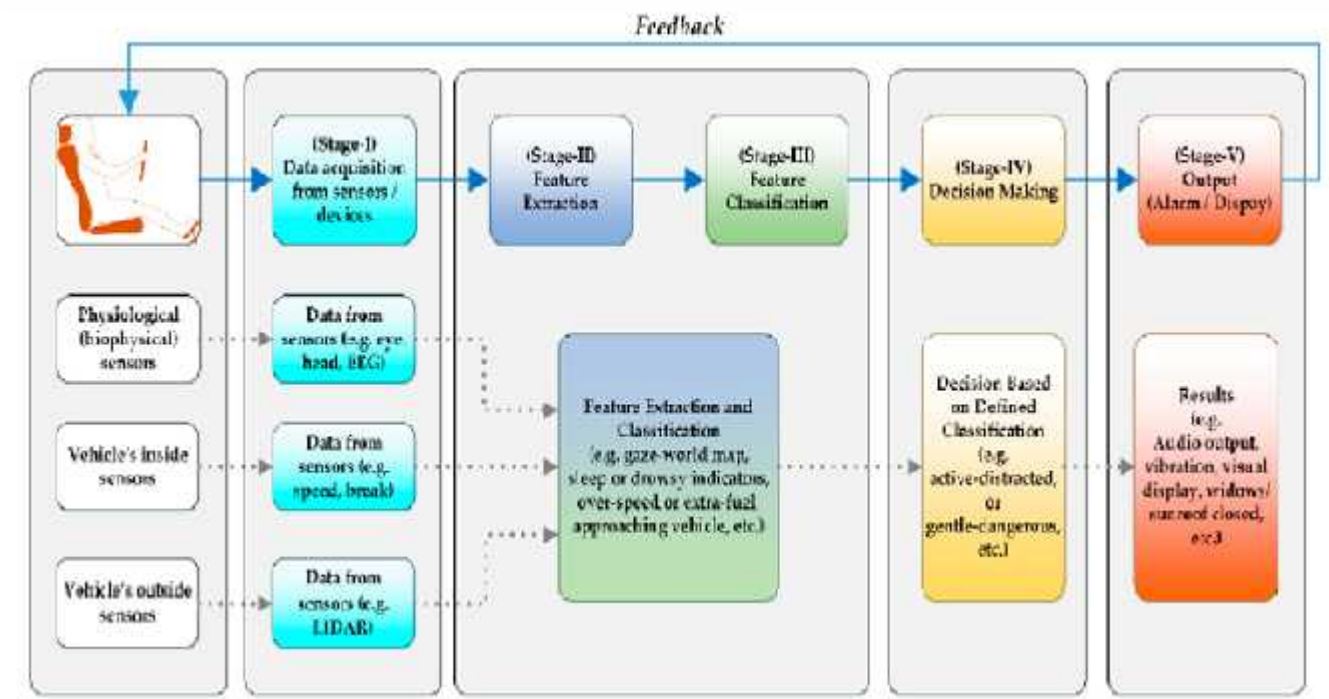


Figure 21 ***Driving Monitoring and Assistance Systems layout***

4.2.1.2 The Design

Data Flow Diagram1

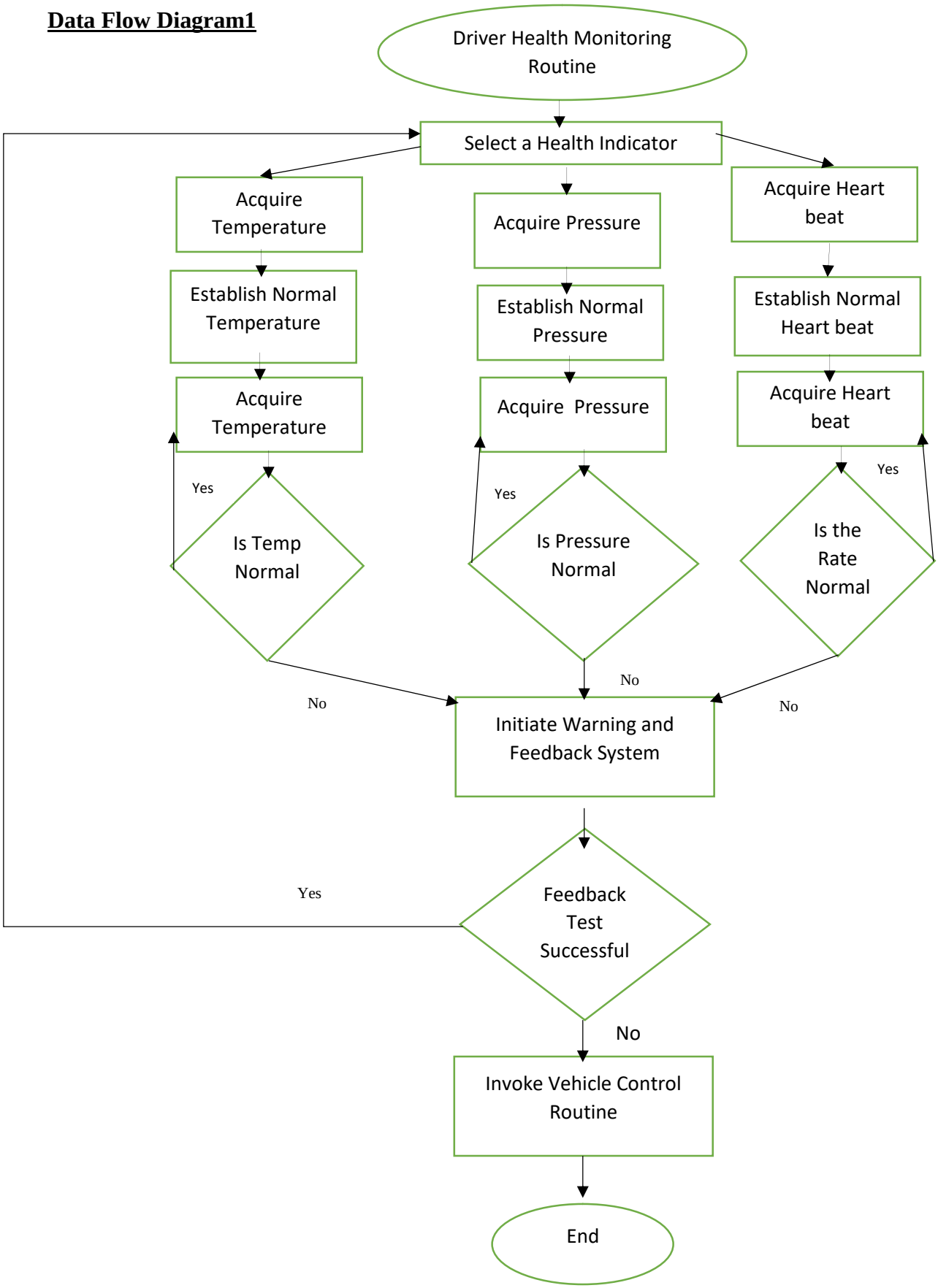


Figure 22 Data Flow Diagram 1

Data Flow Diagram *2*

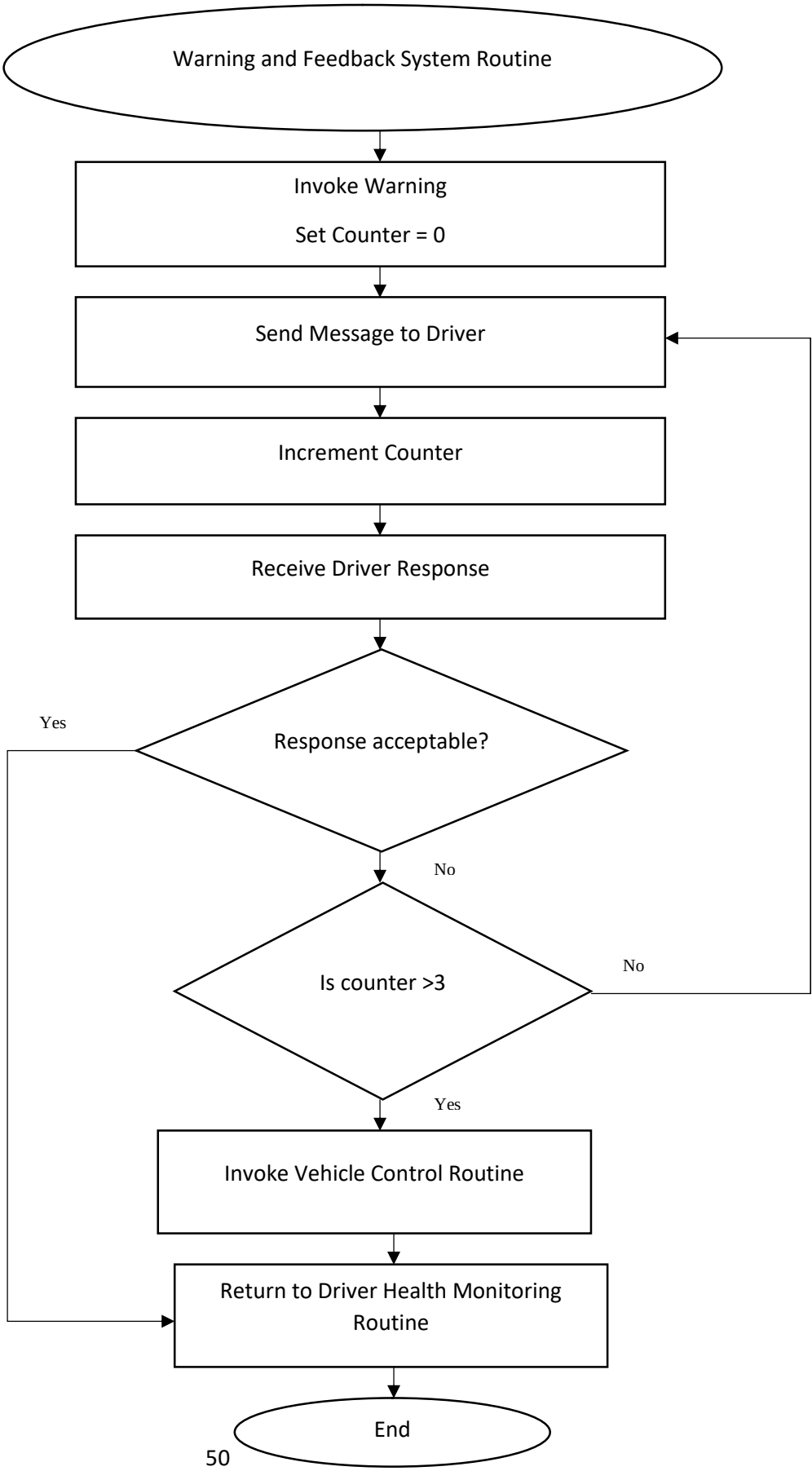


Figure 23 Data Flow Diagram 2

4.2.1.3 Prototype Description

4.2.1.3.1 Components

- ✓ Arduino Pro mini
- ✓ MPU6050 Accelerometer
- ✓ MAX30100 Pulse oximeter to measure heart rate and Oxygen %
- ✓ Bluetooth HC-05 module
- ✓ 3.7v Li-ion 380 mAh smartwatch battery
- ✓ TP4056 charging module
- ✓ 1-slide smd switch

4.2.1.3.2 Software

- ✓ Tinydb android
- ✓ MIT App Inventor

4.2.1.4 Description

- ➢ Pedometer to track walking steps. It tracks walked distance by computing number of walked steps
- ➢ A BMI calculator that has WHO health recommendations depending on users height and weight
- ➢ A Real time Bluetooth UI that displays Heart Rate in beats per minute.
- ➢ The remote wearable pulse oximeter o capture and send blood Oxygen concentration to be displayed on the user interface.
- ➢ The Accelerator sensors on wearable to monitor and send light sleep activity

The software part includes the Health monitor application with UI for user to monitor vitals and sleep activity, BMI, and pedometer feature to monitor steps or physical activity of user

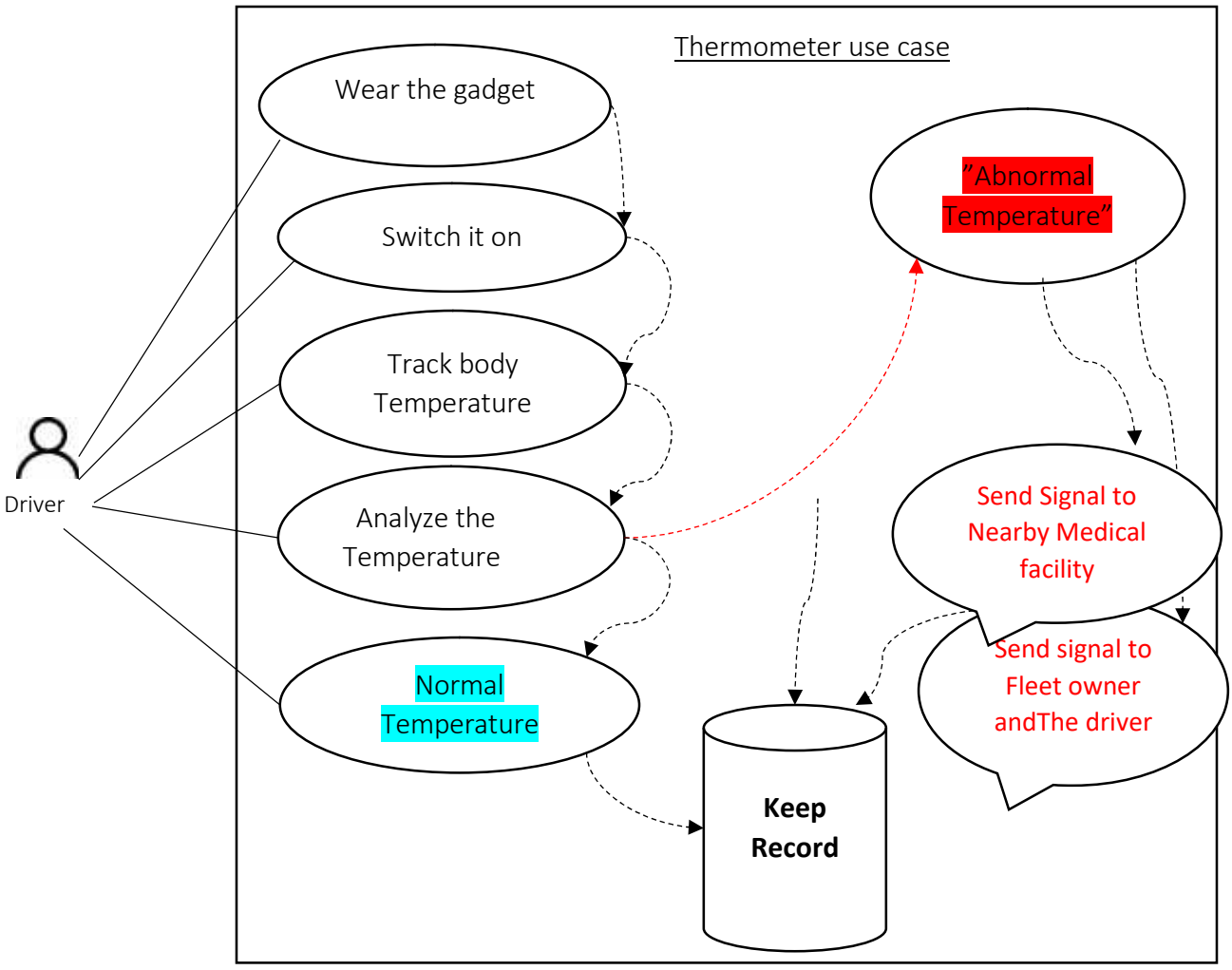


Figure 24 Thermometer use case

Use case – **Blood Pressure**

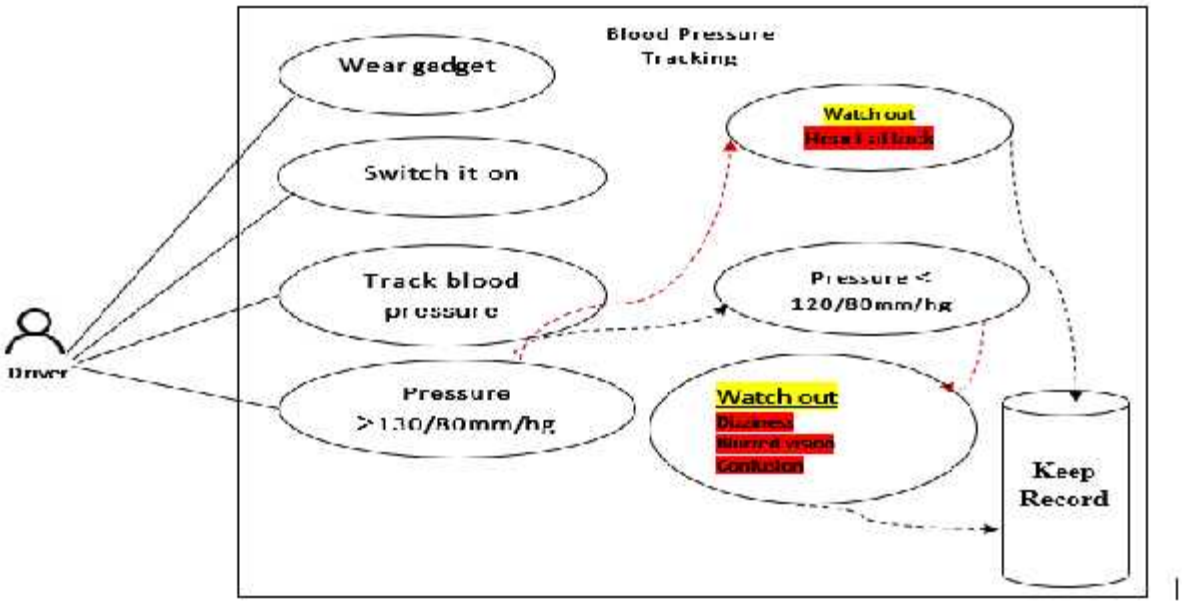


Figure 25 Blood pressure Monitor use case

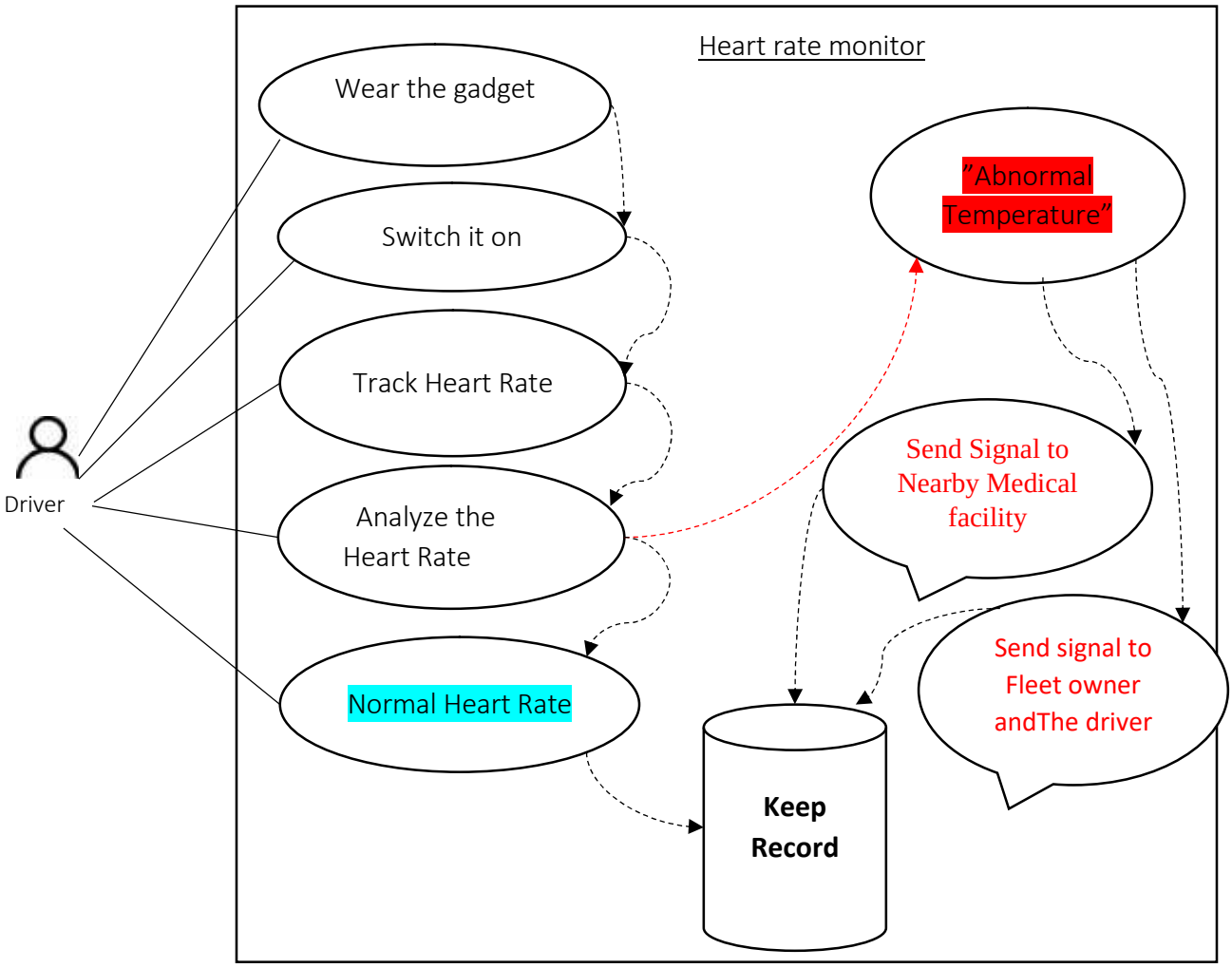
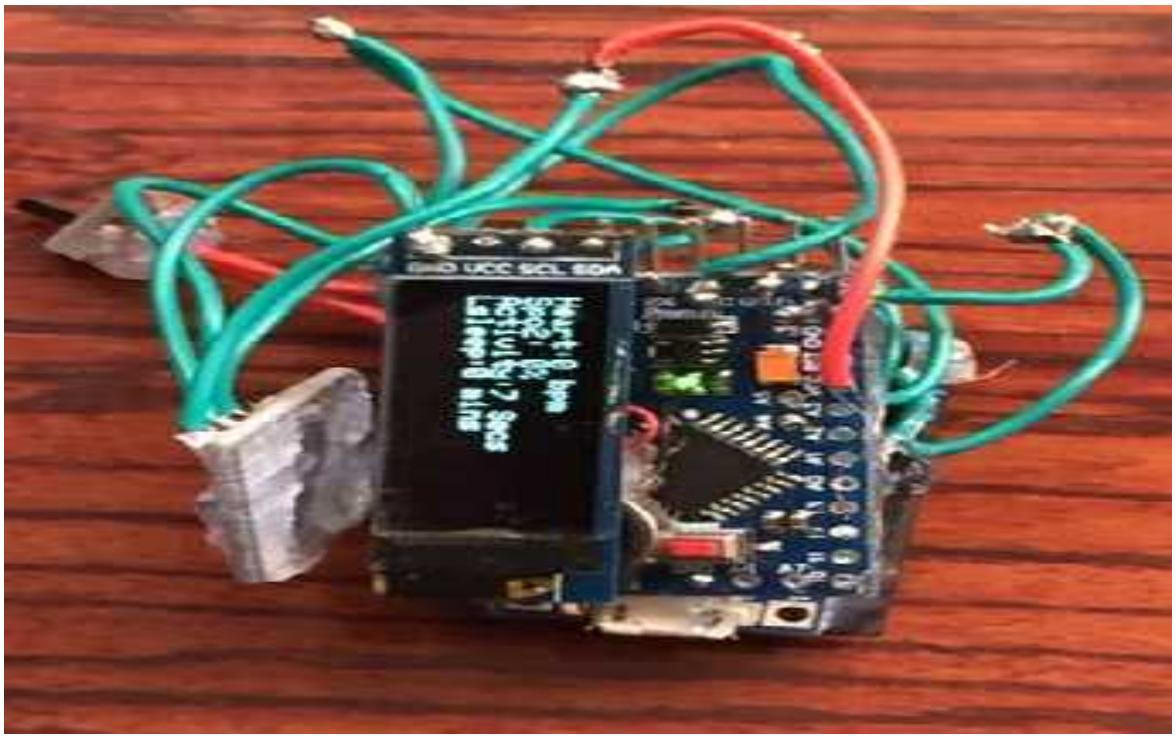


Figure 26 Heart Rate Monitor use case

4.2.1.5 PHYSICAL PROTOTYPE SET UP

Figure 27 physical prototype



4.3 System Overview

This is a real time health monitoring system designed to capture, monitor, and analyze drivers health vitals with focus of regulating and controlling them and ensuring the driver is aware of any eventuality in order to enhance maximum performance in his duties. It additionally completely computerizes the board of data got from the drivers' wellbeing vitals.

Figure 28 BMI Monitor

To check BMI and ensure it is between 18.5 and 25kg/m^2

If less than 18.5. it registers underweight, in case it is above 25 it registers overweight.

Figure 29 Heart rate monitor

This interface will capture the heartrate, blood oxygen and activity count. The heart rate should be 60to 100beats per minute. Anything higher than this may denote a heart condition, in case it is less that this it may denote that one if falling asleep.

The blood oxygen saturation levels should 95% 10 100%.

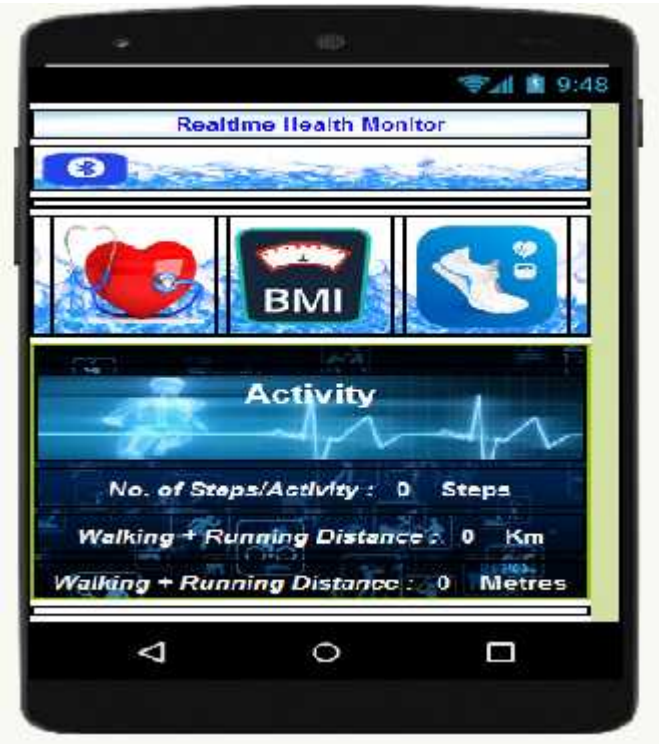


Figure 30 Pedometer

This pedometer should capture the number of steps made in a day.

4.3.1 IMPLEMENTATION

4.3.1.1 Requirements

- ✓ Smartphone
  - Android OS
  - Bluetooth enabled

4.3.1.2 Procedure

1. Install health monitor application in your phone
2. Switch on the gadget
3. Put on the Bluetooth on your phone
4. Search for the gadget (HC 2010)
5. Once you get it click on it and enter password (1234)
6. Double click on the health monitor application icon to open it
7. Once the user interface appears, click on the Bluetooth icon on the interface
8. The interface will read ”Connected” ready for use.

5 CHAPTER FIVE: RESULTS AND DISCUSSIONS

The wearable device was later taken to the targeted group and the drivers were asked to wear them and give their views on what they felt about them. They give their views on how they found the wearable device, to what extent the device could monitor their health and how all this could enhance their overall performance as truck drivers. 10 drivers took part in this discussion.

5.1 Findings

The drivers were 40 ± 5 years of age all round, and had been in the calling for quitesome time. Every one of them were male, and the vast majority of them drove significant distance substantial products vehicles. Researcher identified three themes from the drivers' narratives. The themes refer to how they found the wearable device, to what extentcould the device monitor their health and how this could enhance their driving performance.

5.1.1 Views on the wearable device

When asked how they found the device: most of them were like "don't track us, are you sure it is not a tracking device" others feared that I wanted to check their Covid 19 status which they were not ready for.

Another respondent felt that the garget should monitor their blood pressure which was their biggest threat. He argued that their working environment was the greatest cause to the pressure. Their employers were always on their necks incase they delayed delivery of goods. Yet they fail to put into account the challenges on our road like traffic police, jam.

Some felt that the gadget should not only monitor our pressure but also administer an injection once they found it to be high.

Others were so bitter that the "truck drivers" had become the laughing stock to the society. Every time a disease came up, the government always blamed them of spreading the same, i.e HIV, and now Covid. They didn't understand why it was so yet they are also human and fathers to children like any other Kenyan.

Others felt that the wearable device should monitor their body temperature, to avoid the harassment they were getting at the border. They argued that with the device their temperature could be monitored continuously and incase it raised, a red alert should be sent to the driver, nearby health facility and the fleeting company headquarter. So instead of going through the

testing process, they could go straight to seek medication. Some of their verbatim were as follows:

"Don't track us, we are tired of these tracking devices"

"Hata wewe umekuja kutupima covid harafu tukipatikana mnatuweka quarantine, sisi hatuna pesa rudi ulikotoka"

"Our main challenge here is blood pressure. Most of us here are suffering from hypertension as a result of this kind of our job. We have stress from every corner: our government, our employers and our families. "

"If only that gadget could monitor our pressure throughout and incase it goes high to administer an injection automatically without our knowledge. Hii kitu imetusumbua sana. Hatuna pesa ya kununua madawa yake"

For me am very bitter with the government: how comes we are always to blame of the spread of every disease that comes in kenya. Kwanza ilikuwa HIV sasa ni Covid 19. Kwani sisi sio watu kama wengine. Mjue sisi pia ni mababa kama wale wanaume wengine"

"I wish this gadget could track and monitor our temperature. This would enable us avoid the kind of harassment we normally get at the border. Incase of an increase in temperature, the driver should be alerted via mobile phone and a similar alert should be sent to the company headquarter and a nearby medical facility. Instead of having to queue awaiting testing this particular driver can go directly to the facility to get treatment"

5.1.2 Usability of the gadget

Most of the respondents felt the gadget was very light in weight so comfortable to wear on ones wrist. Another one felt that it was easier to use since once worn and switched on, the gadget automatically captured the wearer's heart rate, pressure and temperature and displayed on the monitor.

A respondent felt that the gadget could easily be accessed through the smart phone once a Bluetooth connectivity had been established with the gadget. The vitals being captured could be displayed on ones phone and incase of a spike a warning could be shown to the driver.

Some verbatims

"This gadget is very light in weight and comfortable to wear."

"it is easier to operate since once worn on the wrist and switched on it automatically captures the vitals"

"Kumbe I can also use my phone to track the recordings on this gadget, this is so cool"

5.1.3 How use of the wearables would enhance drivers' performance

Later they were asked how they thought use of the wearables would affect their performance. Some of them argued that if drivers health was well monitored and controlled then the driver would not suffer poor vision as it is the case with poor health. The good vision would enable the driver would be good in tracking i.e staying on their path while driving just as avoiding different vehicles and hindrances out and about.

Others argued that with good health one would do good judgement. For example in risk assessment, avoidance of hazards on the road as well as emergency decision making incase a situation dictates so.

Some said that good health would mean good coordination especially on the wheel. For example one would easily do braking or accelerating in case a situation demands.

Another one argued that with good health monitoring it would prevent sudden death which mostly comes as a result of a heart attack. This is because when ones health is monitored you would administer preventive or curative measures in case of any sign before the situation gets out of hand.

Some also argued that good health would promote safety especially on the road since the number of accident cases would go down. Most of the accidents occurs as a result of the driver dozing off while on the wheel. If the wearable would wake or prevent one from sleeping then this would be a thing of the past. Here are some of their verbatim:

"With good health one can easily do good judgement regardless of the magnitude if the situation he would find himself in. for example risk assessment or emergency decision making"

"Good health means good vision which would lead to good tracking i.e. one to maintain their lane, as well as keep correct distance from other cars"

"Once one is in good health, good coordination especially on the wheel is very easy. This includes steering, braking and even accelerating"

"When ones health is well monitored it will avoid cases like sudden death due to heart attack which is a common cause of death among middle aged men"

"Good health will always promote safety since most of the accidents are as a result of poor concentration i.e. out of sleeping or dozing off"

5.2 Data Simulation and Predictive Analysis

Temperatures in 5 min intervals (Normal 36.4-37.6`C)							
Subjects	**5 min**	**1o min**	**15 min**	**20 min**	**25 min**	**Average**	**Category**
1	36.5	37.1	37.2	38.3	39.2	37.66	Normal
2	37.3	37.9	38.1	39.3	39.6	38.44	High
3	36.4	35.6	35.1	34.9	34	35.2	Low
4	36.6	36.8	36.3	37.1	37.3	36.82	Normal
5	37.5	37.9	38.3	38.7	39.6	38.4	High

Table 9 Simulated Temperature data set

If the temperatures were monitored for 25 minutes, two of the subjects with their average temperatures within range, could have been classified as being normal, two others with their temperatures above the range could be classified has high and one with the temperatures below the range could be classified as low.

Systolic pressure in 5 min intervals(Normal 120-140mmhg)							
Subjects	**5 min**	**10 min**	**15 min**	**20 min**	**25 min**	**Average**	**Category**
1	146	150	162	173	185	163.2	High
2	160	172	186	190	192	180	Very High
3	118	110	92	86	64	94	Low
4	122	134	128	130	123	127.4	Normal
5	130	138	145	160	177	150	High

Table 10 Simulated Systolic Pressure data set

If the systolic pressure was monitored for 25 minutes, one of the subjects withhis average pressure within the expected range could be classified as normal, another one with the pressure far above the range expected could be classified as very high, two other subjects with theirs

above the expected could be classified as high and another subject with the pressure below the expected could be classified as low.

Heart rates in 5 min intervals (Normal 60-100bpm)							
Subjects	**5 min**	**10 min**	**15 min**	**20 min**	**25 min**	**Average**	**Category**
1	75	80	95	86	97	86.6	Normal
2	110	119	125	130	139	124.6	High
3	101	115	121	119	125	116.2	High
4	65	74	83	79	87	77.6	Normal
5	56	42	50	58	49	51	Low

Table 11 Simulated Heart rate data set

If the heart rates were monitored within 25minutes, two of the subjects with average heart rate within the expected range would be classified as normal, two other subjects with average heart rate above the expected range would be classified as high while another subject with average heart rate below the expected range would be classified as low.

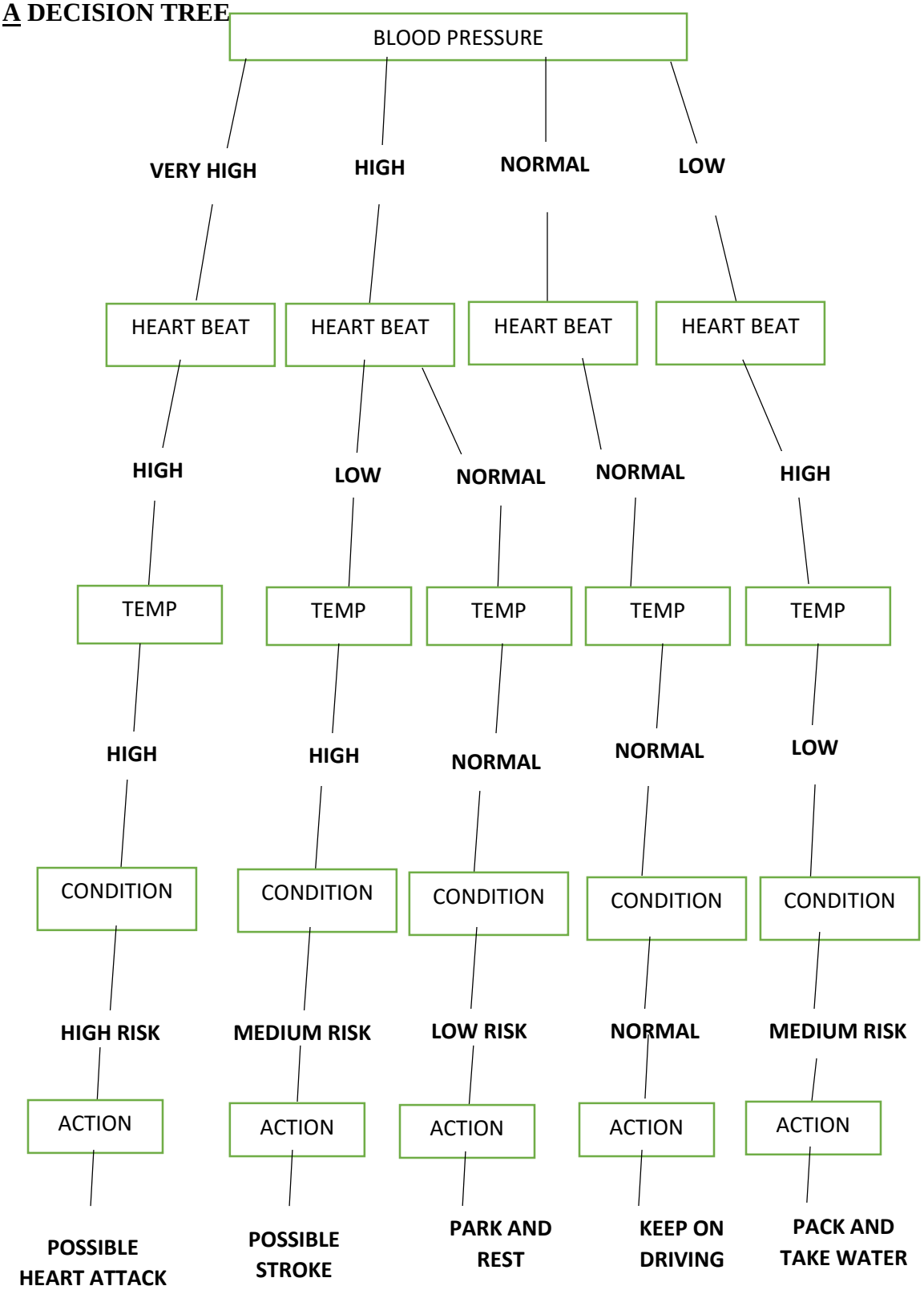
COMBINED VITALS DATA WITH POSSIBLE CONDITIONS AND ACTIONS TO BE TAKEN					
Respondent	**Blood Pressure**	**Heart Rate**	**Temperature**	**Condition**	**Action**
1	High	Normal	Normal	Low Risk	Rest and Take in some water
2	Very high	High	High	High Risk	Possible heart attack
3	Low	High	Low	Medium Risk	Take some rest
4	Normal	Normal	Normal	Normal	Keep on driving
5	High	Low	High	Medium	Possible

				Risk	COVID

Table 12 Predictive Analysis

- If Pressure = High and Heart rate = Normal and Temperature = Normal then Condition = Low risk and Action = Rest and take in some water.
- If Pressure = Very High and Heart rate = High and Temperature = High then Condition = High Risk and Action = Possible Heart Attack.
- If Pressure= Low and Heart rate = High and Temperature = Low then Condition = Medium risk and Action = Pack the car and take some rest.
- If Pressure = Normal and Heart rate=Normal and Temperature = Normal then Condition = Normal and Action = Remain on the wheel
- If Pressure = High and Heart rate=Low and Temperature=High then Condition = Medium risk and Action = Possible Covid.

A DECISION TREE



The above decision tree gives a summary of the predictive analysis derived from the data collected.

Figure 31 Decision Tree

5.3 Discussion

5.3.1 Summary of discoveries

The drivers' perspectives raised three primary stories. The primary story was about how they tracked down the wearable gadget. The second narrative was how the wearable devices could be used to monitor their health and how this could enhance their driving performance.

The drivers were happy to wear and try out the wearable. They described it light weight and comfortable to wear. Once worn and switched on it automatically captured the vitals. They referred to it as user friendly and easy to use.

The wearable device could monitor their heart rate, blood pressure and temperature. Many drivers welcomed the invention of the wearable device for their use, claiming that it would go a long way to help them mitigate some of their health challenges which has been an issue. They argued that they would be ready to use only if they will be assured that no tracking device will be incorporated in the wearable device. However, a fully integrated system is highly recommended to monitor a wider range of vitals incorporating blood sugar, oxygen saturation and even respiratory rate.

With the predictive analysis it will be easier for the driver to take some preventive measures against some of the notorious condition like stroke, cardiac arrest or heart attack. It will also keep the driver enlightened on when to take what action depending on their health conditions.

With a fully integrated system it would be very easy for the driver to gain full coordination, judgement and tracking while on the sterling. As a result the rate of accidents would go down as well as prevent sudden death due to unnoticed complications.

6 CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

As far as anyone is concerned no investigations had recently been directed on transporters wellbeing checking utilizing wearable gadgets in Kenya.

The fundamental examination demonstrated that there is a hole/opportunity inside the transporter's way of life and their wellbeing checking. The greater part of the respondents suggested that their temperature, circulatory strain and pulse be checked.

From the composing assessed, progressing bothers of diabetes may impact safe driving execution. These recall visual retinopathy with related impedances for visual astuteness, loss of periphery vision and faint variety; and lower member periphery neuropathy that may impact pedal control. Furthermore some specific infections like colds, flu, cerebral torments, pollutions, fever, and stomach issues, among others may in like manner sway perspective, center, understanding, and information dealing with, thusly causing drivers' negative responses. Other clinical issues like skeletal muscle tortures and changes, etc may diminish the ability to turn one's head or to play out the significant moves, thusly really impacting driving.

Some of the similar system currently is what we find in some prestigious cars like BMW, AUDI, Mercedes Benz. These vehicles have an inbuilt system to safeguard the driver as well as monitor his health with predictive analysis part yet to be implemented. Such systems are yet to be adopted in the heavy goods truck vehicles. The only systems in these heavy goods truck vehicles are geared towards protecting the goods on board i.e cooling systems but nothing for the driver.

The developed prototype is a health monitoring gadget which can enable monitoring of drivers health and later use the information garnered to do predictive analysis of the driver’s condition to predict of any awful condition awaiting and advise him to take the most appropriate action.

Through the use of such a system it would be possible for a driver to take preventive measures in time to avoid some worst experiences in future.

From the respondents’ views, the gadget is light in weight, user friendly and comfortable to wear.

6.2 Challenges duringthe Study

The following are the challenges the researcher encountered during this study,

- Lack of follow up of the truck drivers as previously scheduled due to their long journey trips and accessibility..
- The development of the prototype also had challenges in that some sensors I.e. pressure sensor was out of stock from the shops here in Kenya and required importation which was not possible due to the pandemic lockdown.
- Limited research work on wearables and health monitoring so researcher relied on preliminary study more to inform the model.
- The lock down as a result of the pandemic disrupted our consultation schedule since some cessation of movement had been put into place.

6.3 Suggestions for further research work

- The prototype could be extended to monitor a wider range of vital including blood sugar, oxygen saturation and respiratory rates.
- The predictive analysis part could also be incorporated as part of the physical prototype so that it could be done automatically after a certain time interval.
- The prototype could also be employed by medics among the patients living with some of these condition I,e, blood pressure, blood sugar to enable them monitor them better.

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