REPUBLIC OF TURKEY
FIRAT UNIVERSITY
THE GRADUATE SHCHOOL OF NATURAL AND APPLIED SCIENCES

AGENT BASED HUMAN-IN-THE-LOOP SIMULATION FRAMEWORK FOR ELECTRICAL VEHICLE SYSTEMS

Master Thesis
Karwan Hoshyar Khalid KHOSHNAW
(142129101)

Department: Computer Engineering

Supervisor: Assoc. Prof. Dr. Mehmet KARAKÖSE

January-2018

REPUBLIC OF TURKEY
FIRAT UNIVERSITY
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

AGENT BASED HUMAN-IN-THE-LOOP SIMULATION FRAMEWORK FOR ELECTRICAL VEHICLE SYSTEMS

MASTER THESIS

Karwan Hoshyar Khalid KHOSHNAW
(142129101)

Submission Date to the Institute: 02 January 2018
Thesis Presentation Date: 18 January 2018

Thesis Supervisor : Assoc. Prof. Dr. Mehmet KARAKÖSE (F.U.)
Other Juries : Assoc. Prof. Dr. Burhan ERGEN (F.U.)
: Assist. Prof. Dr. Ulaş Baran BALOĞLU (M.U.)

January- 2018

ACKNOWLEDGMENT

Above all else, my thanks are routed to GOD for inspiring me with forbearance and power to perfect the research.

I would like to express the deepest appreciation to my Assoc. Prof. Dr. Mehmet KARAKÖSE who has the attitude and the substance of a genius. Without his guidance and persistent help this dissertation would not have been possible.

Also, it is my great honor to thank the Computer Engineering Department staff for being kind and helpful to me throughout my studying, Special thanks are extended to Prof. Dr. Erhan AKIN for his professional advice and for taking part as an advisory committee in my thesis presentation and their inestimable feedbacks which enhanced and improved my research.

I would like to record a word of gratitude, appreciation and thanks for Beautiful Elazığ City and all of its people for their help and good behavior.

Acknowledging my beloved family for their supports and encouragements in the hard times, I am forever indebted to my family especially my mother, my brothers and my lovely wife for all their helps both materially and morally.

Finally, I'm grateful to all of my Friends and to whoever helped me in conducting this study, Special thanks are extended to my Friends Shayda ISMAIL, Zardasht SHWANY and Twana SHWANY.

Karwan KHOSHNAW
Elazığ, 2018

TABLE OF CONTENTS

ABSTRACT

Agent Based Human-in-The-Loop Simulation Framework for Electrical Vehicle Systems

With the end goal of creating safe agent based human in the loop frameworks for electrical vehicles, exact and accurate models of human conduct must be produced.

This thesis portrays a trial setup for human in the loop simulations. An agent is an autonomous computational body arranged in some condition, and it is fit for autonomous associations with this condition. The specialist concentrates on creating proving ground essential for gathering driver data that aides in social affair practical information, while controlling the encompassing condition and looking after wellbeing. The driving test system is intended to reproduce any strengths that the driver feels during the driving. The set up permits noteworthy control and adaptability in a genuine reproduction ecological circumstance. Multi-specialist tests which concerns driver focus can be directed on this proving ground. The paper introduces the use of driver displaying that predicts the driver conduct over long time circles for usage in self-governing system. We extend the previous studies which concentrate on setting forecasts fusing directions saw from practices of cross breed and self-ruling vehicles and the nonlinear mental state. The calculations utilized as a part of the human, and the tuned in reproductions are basic to give the drivers state and help in planning a successful final model. Exact and exact driver demonstrate modified to an individual can be created. Utilizing adaptable calculation and reasonable information.

Keywords: Human-In-The-Loop Simulation, Agent, Electric Vehicles, Sensors.

ÖZET

Elektrikli Araç Sistemleri İçin Etmen Tabanlı Döngüde İnsanlı Benzetim Çatısı

Elektrikli araçlar için döngüler çerçevesinde güvenli ajan tabanlı insan yaratmanın nihai hedefi ile insan davranışının kesin ve kesin modelleri üretilmelidir. Bu tez, halka simülasyonlardaki insan için deneysel bir düzeneği açıklamaktadır. Bir aracı, belirli koşullarda düzenlenmiş otonom bir hesaplama organıdır ve bu şartla özerk ilişkilere uygundur. Uzman, kapsayıcı durumu kontrol ederek ve refah içinde bakarken, toplumsal meselelerde pratik bilgilere yardımcı olan sürücü verileri toplamak için gerekli kanıtlama zemini yaratmaya odaklanır. Sürüş test sistemi, sürücünün sürüş sürecinde hissettiği tüm güçleri yeniden üretmek için tasarlanmıştır. Kurulum, hakiki bir üreme ekolojik koşulunda kayda değer kontrol ve uyarlanabilirliğe izin verir. Çok uzmanlık testleri ve sürücü odaklılık konusundaki testler bu ispat zemine yönlendirilebilir. Bu çalısma, sürücünün kendi kendine yönetim sisteminde kullanılması için sürücünün uzun süre çevreleyen davranışlarını öngören sürücünün kullanımını tanıtmaktadır. Kaynaştırma yönergelerini çapraz cins ve kendi kendini yöneten araçlar ile doğrusal olmayan zihinsel durumlardan örnekler üzerine oturtmak üzerine yoğunlaştıran geçmiş değerlendirmeleri genişletiyoruz. Reprodüksiyonda ayarlanmış insanların bir parçası olarak kullanılan hesaplamalar sürücülerine durum bilirmede ve başarılı bir son model planlamada yardımcı olmak için temel bir işlemdir. Uyarlanabilir hesaplama ve makul bilgileri kullanmak suretiyle, bir kişiye modifiye edildiğini gösteren kesin ve kesin sürücüler oluşturulabilir.

Anahtar Kelimeler: Döngüde İnsanlı Benzetim, Etmen, Elektrikli Araç, Duyor gorler.

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

3D	**:** Three Dimensional
ACT-R	**:** Adaptive Control of Thought-Rational
BAE	**:** British Multinational Defence, Security, and Aerospace Company
BDI	**:** Belief-Desire-Intention
BEV	**:** Battery-powered Electric Vehicles
CPS	**:** Cyber Physical System
EEG	**:** Electroencephalograph
EM	**:** Electric Machine
EVS	**:** Electrical Vehicle Systems
EV	**:** Electrical Vehicle
HIL	**:** Human-In-The-Loop
ICE	**:** Internal Combustion Engines
PC	**:** Personal Computer
SLAM	**:** Simultaneous Localization and Map-building
SQP	**:** Sequential Quadratic Programming
USAR	**:** Urban Search and Rescue-mission
USB	**:** Universal Serial Bus
UV	**:** Unmanned Vehicle
ZEV	**:** Zero Emission Vehicle

1. INTRODUCTION

Nowadays, a large portion of human movement would be done through Technology to work together and serve humanities, however to enhance those exercises in greatly keen way and being an adequate support for humanities it ought to be done through humanities intelligence himself in the method for human's exercises and keenness in down to earth design. Most likely, those things are fanciful toward the starting then have a place with hypothetical thoughts. Be that as it may, these hypothetical contemplations ought to be sorted out and all around wanted to serve humanities in the method for doing people exercises all through development and thinking in efficient way. It should be possible from getting advantage in technology structure of speculation and human's development.

Computer science, robotics and artificial intelligence are just some of the overlapping areas that all industry may benefit [1]. Human interference is definitely fundamental for certain circumstance as switching autonomous algorithm of robot since several of the assignments ask human support, while other missions are performed by robot with satisfied outcomes [2]. Robotic research areas, for example, scope or Simultaneous Localization And Map-building (SLAM) for various robots, are very much created and autonomous robots can achieve the task quick and effectively. However, finding a human sacrifice in the Urban Search And Rescue mission (USAR), and the sensor information is frequently untrustworthy. For this situation, human acknowledgment works better than the autonomous algorithm. Besides, when a robot experiences possibilities, for example, gotten in a hindrance, robot is consistently not ready to escape, which require giving over the control to the administrator [3, 4].

As a matter of fact, precise and accurate models of the said human behavior advance human-in-the-loop systems that provide harmless control mechanisms as well as offering response to the driver. The probable set of actions is determined and they can be used during driving of electrıcal vehicles. There are two types of control frameworks that can be easily integrated and they include switched and augmented control [5]. The applicable models have to account for human cognition and the examination of one’s own behavior is simple and well controlled.

On the other hand, the decision-making process that is involved in a human comprises engineering techniques, economics-based models, and psychology. Human decision-making involves three major engineering techniques: Soar, Adaptive Control of Thought-

Rational (ACT-R) and BDI. The BDI paradigm is more successful in software systems as it allows the use of programming languages in describing human reasoning. The human-in-the-loop simulation capability allows evaluation in a realistic environment, which allows engineers to optimize the vehicle before a hardware prototype is made.

Talking of an example, the BAE systems use a human-in-the-loop development tool to provide access to engineering and. This is important to help optimizing electric concepts is. Teams are then able to monitor various concepts involved in the vehicle, such as rate charge rate of the battery and its overall performance (Fiksel 40). Some of the properties that a human-in-the-loop system should achieve include safety and effectiveness. Various approaches that can be used to determine the safety can be achieved in an electrical vehicle. Two main approaches are the use of sensor systems and controllers and the creation of systems that cannot physically harm human beings. However, human-in-the-loop systems is difficult to accomplish safety measures because human actions are unpredictable. Thus, a safe human-in-the-loop system has to be developed and incorporated into a safety algorithm to achieve semiautonomous control (Rahimi-Eichi 15).

1.1. Overview of the Thesis

Today, there are many technical and conceptual challenges for individuals with backgrounds. Problems can occur when demonstrating the way complex situations are generated from interacting small grain elements and on the actual modelling process for concretizing theories. This thesis aims at explaining by what means a framework that systematically adapted to the human user can be constructed. Notably, a similar arrangement is managed by creating a combination animating complex agent operations and high-level languages for modelling agent behaviour in spatial areas. The agent behaviour will be represented by language primitives, such as move around the objects, leaving them on your right side rather than calculating convex paths and hulls around the obstacle polygons [6]. Agent actions are connected to animation patterns so that the running simulation 3d visualization is generated without referring to the low-level 3d apparition [7].

Simscape is utilized, for running driving simulations [7]. Until this programming is regularly utilized for replaying gathered information or for running investigations where real-time execution is pointless, a correspondence convention between the software and the simulator, was put in place to achieve real-time simulations with the simulator, right now running at a rate of 60 Hz. Inputs to the test system stage is acquired despite the fact that the joystick work hinder from Matlab's Simulink, which is then utilized as the contribution to the drives of the vehicle through Simscape. Position of the vehicle, in expression of pitch, yaw, and roll, is gotten from Simscape and sent to a Matlab content through Generate Simulink Blocks (GSB). Packaged as a particular structure that is sent to the simulator control PC, again finished GSB, to change the position of the test system suitably. This setup is shown in Figure 1.1. Each of these signs have picks up related them, which have been hand-tuned to re-make the sensation driving [7, 8].

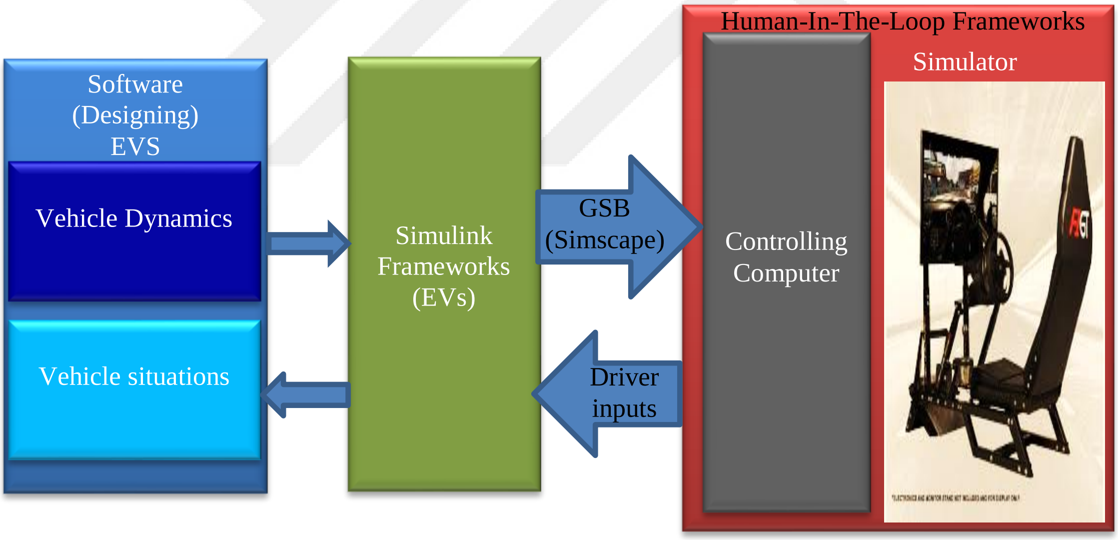

Figure 1.1. Block diagram for human in-the-loop simulation for electric vehicle systems [7].

The human-in-the-loop agent-based simulation will incorporate the human behaviours and characteristics captured by computer vision techniques for Electrical Vehicle Systems. It will be effective crowd control using electrical vehicles to help in modelling, detection and tracking [9]. The simulation will communicate with the crowd detection module in the UV computer in real time. Furthermore, it will develop the plans for simulated individuals based on the parameters extracted from the actual crowd. Subsequently, the social force based model will be sent to the tracking module to predict the future location for UVs planning purposes. A human-in-the-loop simulation is utilized as a method to evaluate the effectiveness of electric vehicles [10]. It is used as a preliminary outcome in identifying the vehicles capacity in terms of maximum speed and the ability of the alternator to recharge the battery.

Agent-based human-in-the-loop control has been a major focus in many research projects that consider by what means humans and automation can function together in a joint environment. Nevertheless, setting up such experiments and testing algorithms is difficult due to lack of realistic simulations and safety concerns [11]. The driving simulator is developed to address the issue, focusing on driving experiments. Besides, human beings are unpredictable since their actions are dependent on metal stats such as happy, sleepy or angry. Experiments with distracted drivers are difficult and dangerous since the researcher cannot actively tell them not to text while driving in a real vehicle. In order to ensure the safety, the computer simulation from electrical vehicles is implemented to gather data on driver behaviours. Nonetheless, the major challenge is a lack of realism in the simulations [12, 10].

The ongoing transformation of energy supply continues to be a challenge in current human life. The concern is by what means energy would change and the abilities to be added in current electrical vehicle systems to operate with different types of renewable energy sources and to make it sustainable and environmentally friendly. The mentioned simulation is a basis for an innovative simulation paradigm that shows a great prospective in development [13]. What makes the model unique is due to its symbol of multi-agent system that attributed to system incorporating the interactive actors in a distinctive environment. Notably, it is effective in application by those people with limited experience in realms of math and formal approaches, for example, empirically working teachers, scientist, and scholars.

Electrical vehicle systems advantage tight integrals of computing resources and physical components. These systems have rigged a significant part in serving humans comprehend and control the milieu. To do as such, numerous electrical vehicle systems employ humans as an outer segment, notwithstanding the control loops. At an abnormal state, humans freely couple with the control circles. At times, people can assume control over the control loops when fundamental or sought. For instance, programmed guiding of a flying machine is liable to the pilot's caution of when to start manual control. Another example is a journey control loop for autos that basically keeps up steady speed, without taking the driver's behavioural state into thought. Pushing ahead, we trust that Cyber Physical System (CPS) frameworks will have a more grounded tie in the middle of human and control loops, or the idea of human-in-the-loop simulation. Moving people from outside to inside the circle, (CPS) frameworks can give better reaction in terms of exactness and opportuneness [7, 14]. Proceeding with the case of vehicles, we take note of that street well-being is not simply keeping an adequate separation between two autos, additionally considering the driver's physiological state (exhaustion, outrage, inebriated, and so on.) and practices (diversion, whimsical guiding, and so on.). At the point when the driver is unfit to keep the wellbeing or fuel proficiency of the momentum trip, the car can instantly respond and flag cautions, or even wrestle control from the driver [8, 11].

Human practices can be erratic (or incompletely unsurprising), which adds instability to the administration certification of a tight control circle (e.g., reaction exactness and convenience). Human conduct displaying is the present practice to minimize this vulnerability by foreseeing from learning. In any case, tight control circles in CPS frameworks mean the conduct displaying necessities to precisely react in a brief timeframe. This stringent prerequisite proposes required progress in human conduct displaying and observation notion. [15].

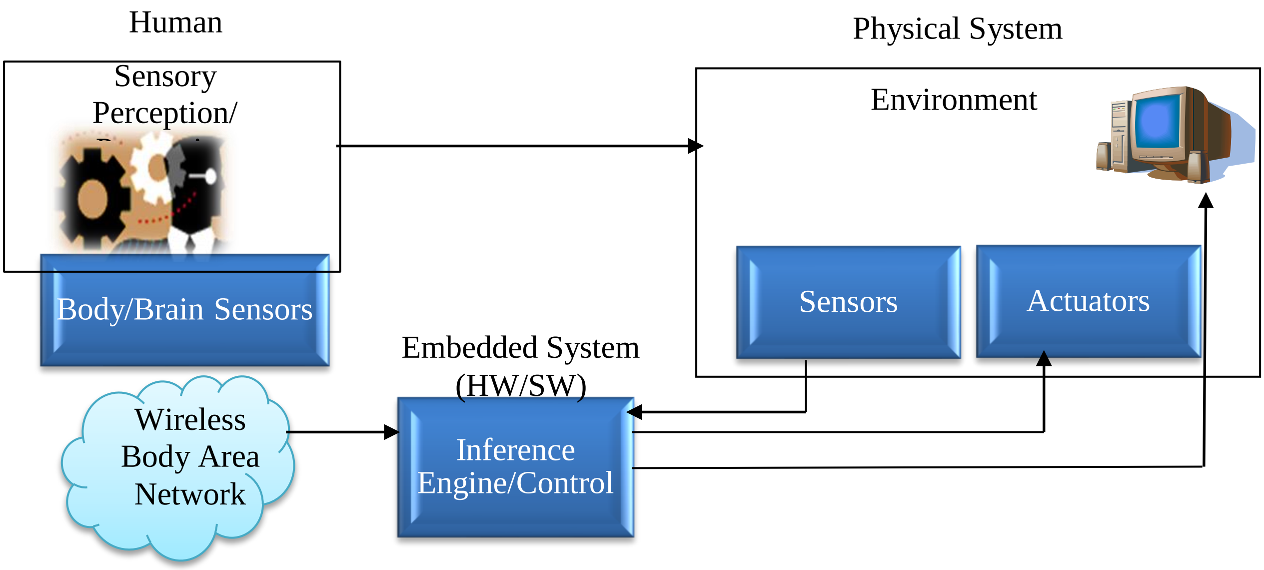

Figure 1.2. Human In-The-Loop Simulation System [5].

Manual control of a vehicle (e.g. aircraft, helicopter, car…) requires the human controller to proficiently guide the vehicle along a specific way while being annoyed by disturbances. The pilot will make utilization of all accessible tangible data (mostly visual and vestibular) and earlier information to upgrade the control execution and/or lessen exertion. Manual control conduct is contemplated to enhance vehicle outline, and models can be utilized to simulate the reaction of the joined pilot-vehicle framework [16]. Existing models of manual control conduct just consider a feedback component, i.e., a control reaction on the mistake between the objective and the framework yield. The feed-forward segment, i.e., a control information reacting to the reference specifically in an open-loop way, was theorized much of the time in writing, yet was never concentrated on nor distinguished from human-in-the-loop experimental data in Figure 1.2. Developed the identification methods to study feed forward behaviour, and also investigated this behaviour in control tasks representing the helicopter roll-lateral sidestep manoeuvre.

1.2. Electric Vehicles

Each vehicle system, such as cars, submarines, trains or any vehicles that joins at least two exporter of energy that can straightforwardly or un-straight forwardly provide populace power is an electrical vehicle system [17].

An electric vehicle systems (EV) is a kind of hybrid vehicle system which joins an inward conventional engine (ICE) impetus system with an electric drive system [18]. The closeness of the electric power prepare is planned to accomplish either preferred mileage over an ordinary vehicle system or better execution.

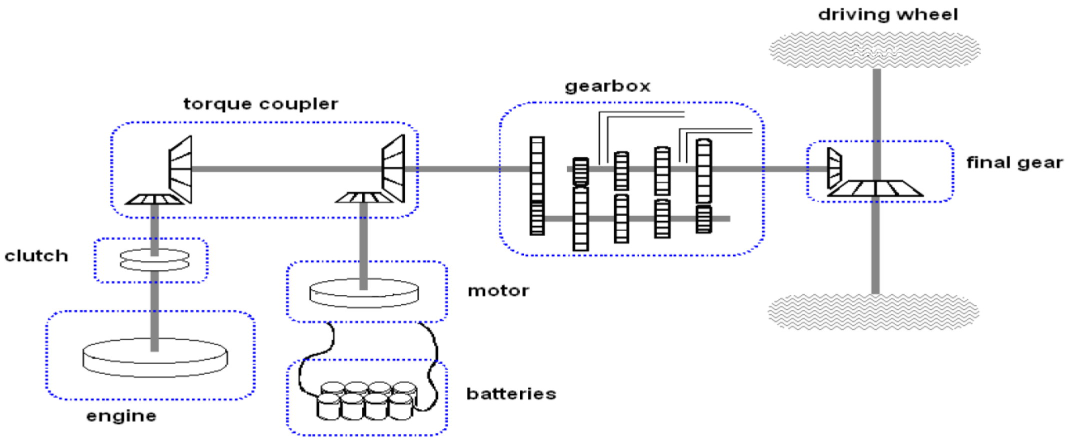

Figure 1.3. Schematic of an electrical vehicle system [6].

In the figure 1.3. shown, the modern electric vehicle systems make utilization of competence-improving technologies, such as reconditioned braking, which changes over the vehicle's kinetic power into electric power to charge the battery, as opposed to wasting it as heat-up power as ordinary brakes do [19]. A traditional vehicle has a mechanical drive prepare that incorporates the fuel tank, the ignition motor, the gear box, and the transmission to the wheels. An electrical vehicle system has two drive trains, one mechanical and one electric. The electric drive train involve battery, an electric engine, and power electronics for control [17, 20].

1.3. The Optimization in Design of Electrical Vehicle Systems

The best EVs design target at improving fuel economy and lessening emanations liable to user’s contentment with their drivability [21, 52]. Nevertheless, electric vehicles are complicated electromechanical systems inclosing styling parameters. A succeeded EV styling requires ideal voluming of its key mechanical and electrical parts. Likewise, for more EV competence, ideal administration of the power influx, control plan is required. In this manner, in the styling operation of a EV, there is an expansive assortment of outline variable decisions, including EV arrangement, key mechanical and electrical ingredients volume and control parameters [22].

Electric vehicles have various design factors and additionally numerous design aims which are oppositing. In addition, many design restrictions should likewise be satisfied all the while. Furthermore, sizes of powertrain segments and control system parameters are coupled and impactsly affect the execution of the vehicle [23, 53]. The impacts of these styling parameters on the targets are non-monotonic. Therefore, the improvement of an electric vehicle system can be detailed as a multi-objective obliged non-linear streamlining issue.

Looking at the significance of the practical case. The enhancement algorithms sophisticated to tackle electric vehicle optimizing in the current writing can be generally grouped into two classifications: gradient based algorithms and petty-free strategies [24].

Gradient-based algorithms, for example, sequential quadratic programming (SQP), utilize the derivative data to fix of this issue [25, 54]. The main disadvantage of these techniques is that they are frail at cosmopolitan improvement. In the mean-time, these look strategies require solid suppositions for the goal work, for example, coherence, differentiability, goodwill of the Lipschitz condition and etc., which can't be measly supposed for this problem.

Derivative-free techniques, for example, genetic algorithms [26], or particle swarm optimization have been confirmed out to be an appropriate way to resolve of the EV design optimization issue. And with such as, the nearly majority of these techniques transform the multi-target optimization issue into a solitary target advancement issue by distributing weights to each of the goal capacities (beforehand methods). In this class, the initial multi-target issue is changed into a mono-target problem by amassing all goals or thinking about one goal as the primary goal and different ones as restrictions. The combined flaw of these mode is that a lone arrangement is acquired after optimization. To discover another arrangement, the client needs to restart a streamlining keep running with new issue detailing by adjusting the weight coefficients or by expressing another primacy. In addendum, the Pareto front is in comprehensive not homogeneous, bent or even continual and the non-ruled arrangements might be gathered in a similar area with the goal that the fashioner decision is restricted. On the other hand, the vast majority of the past research potential considered the advancement of powertrain part estimating or control framework parameters solos. Therefore, the powertrain part and control system parameters are coupled, however, it is hard to locate a worldwide ideal for the styling parameters. Accordingly, it is important to think about the synchronous improvement of powertrain and control system parameters of EVs [27, 56].

Different PC programs, for example, ADVISOR [15], PSAT [28] etc. are obtainable for the analyses of EVs. These apparatuses have some depend-in optimization countenance, including the capacity to naturally estimate the powertrain segments subject to client selectable execution imperatives. In addendum, they can be utilized to choose appropriate controller parameters to maximize the fuel economy and decrease emissions, but, the two capacities are not accessible together from the GUI [29].

1.4. Objective of the Thesis

The main objective of this study is to close the hiatus between computation capacity and human capacity in the field of high-level decision making. This objective is predicated on the way that computers are especially capable in bringing lower-level computationally dense tasks, while humans surpass at tasks including absolute however. This study looks to distinguish intelligent methods for joining computer and human decision leadership abilities for learning answers of complex choice issues.

This study proposes agent-based human-in-the-loop simulation which incorporates the simulation framework characteristics and behaviours model techniques, for effective simulation models to control electric vehicles. Four major functions needed in EV simulation include: designing change, modelling tests, document reports and evaluation results. The proposed simulation communicates with the designing change tests in the electric vehicle on-board computer in real-time, developing plans for a number of simulated design-individuals based on the parameters extracted from the real test data. Next, the real tests based modelling is used in the simulation to interpolate documents for moving the simulated individuals to their planned destinations. Finally, these documents are sent to the evaluation results for a more realistic prediction of simulation future location for the electric vehicles path planning purposes. Preliminary results reveal significant improvements in performance measures for this human-in-the-loop simulation framework, which demonstrate the effectiveness of the proposed methodology.

1.5. Organisation of the Thesis

The organisation of the thesis is as follows:

Chapter 2: Human-in-the-loop simulation: in this chapter human activity and simulation framework for electrical vehicle systems. Is explained agent-based human-in-the-loop simulation framework: this composed work is an instructive based idea as robotic control agent-based human-in-the-loop is an energizing and high test look into technologies work. Further, sensor assumes, a critical part in robotics, is explained Sensors are utilized to decide the present condition of the framework. Robotic applications request sensors with high degrees of repeat-ability, exactness and unwavering quality. Flex sensor is such a gadget, which fulfill the above undertaking with an incredible level of precision. The pick and place operation of the robotics arm can be productively controlled utilizing micro controller programing. An agent-based model is a type of computation model which simulates the actions and relations of autonomous agents to evaluate the whole system. In brief, an agent, in this case, is an automated computational model located in a specific environment and interacts with this setting in an automated and effective way. Initially, electrical vehicle systems (EVS) was developed to overcome the limitations of battery-powered electric vehicles (BEV) as well as internal combustion engines (ICE). EVS systems unite conventional propulsion with an electric machine and electrical energy storage systems. Indeed, it becomes important that once EVS are enhanced in the electric form, it obtains zero emissions.

Chapter 3: Purposed Approach: this section contains algorithms and calculate of the model using mathematical formulae. Various algorithms are used to ensure the effectiveness of human-in-the-loop systems. The hierarchical algorithm is effective in making a context-aware system and incorporating the different factors involved, for example, the driver mode. Finally, simulation for EV systems with all components is given.

Chapter 4: Simulation and results: this chapter includes results and agent based human-in-the-loop simulations such as virtual sensing to help in sensing the virtual environment. During simulation procedure, the simulator is connected to the electric machine so that all computational associated with environmental mapping and vehicles control achieved by the embedded computer. Furthermore, the obtained results are inconsistent with those obtained with the simulator. The experiment proves that the accuracy decreases over time just as expected. The outcome is partially explicated by the suspicion of the environment, that may change drastically within as short period of time.

Chapter 5: This chapter has conclusions and discussion about the commitments of this research task.

2. HUMAN-IN-THE-LOOP (HIL) SIMULATION

A human-in-the-loop (HIL) simulation is a demonstrating structure that requires human reactions. Customary simulation thinks about see human cooperation as an outer data to the framework being considered. In any case, investigations of complex frameworks in today's technological scene must incorporate human as dynamic members [30]. For example, a study of highly automated call centers must include human judgment and decision making and the accompanying task context. The emergence of HIL technologies, therefore, enables researchers and practitioners to investigate the complexities of human-involved interactions from a holistic, systems perspective. An appreciation for how HIL simulations can be used to study human involvement in complex systems, and an understanding of the current research thrusts involving HIL simulations [31].

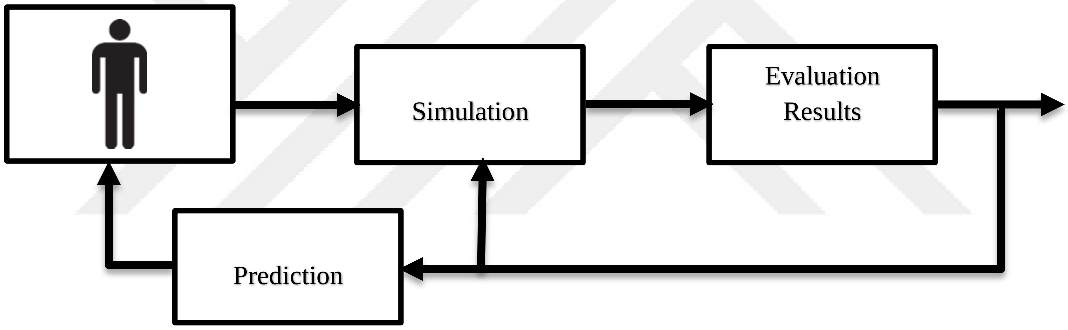

Figure 2.1. Block diagram for human-in-the-loop simulations.

Classic simulation studies see human cooperation as an external input to the system being considered. Similarly, studies of complicated systems in today’s technological landscape must include humans as dynamic members. The rise of HIL technologies, therefore, empowers researchers and experts to investigate the complexities of human-involved collaborations from a comprehensive, systems perspective. The comprises of contributed sections from specialists in community furthermore industry in the zone of human-in-the-loop simulation. By understanding it, the reader should gain a comprehension of what an HIL simulation is and how it contrasts from traditional simulations, a thankfulness for how HIL simulations can be utilized to study human inclusion in complex systems, and a comprehension of the current research pushes involving HIL simulations [32, 33], as shown in block diagram for human-in-the-loop simulation in figure 2.1. Simulation is the creation of a model that can be manipulated logically to decide how the physical world works. The traditional simulations simulate, design control and test in simulation. Simulation has become all most the factor design technique for all control system designs today [9].

Simulation is the tradition of the process of a real world procedure or system after some time. A simulation requires a model; which represents the key attributes or practices/elements of the picked physical or theoretical system or operation. The model performs to the framework itself, while the simulation performs to the process of the system after some time [34].

2.1. Agent-Based Human-In-The-Loop Framework

An agent-based model is a type of computation model that simulates the actions and relations of autonomous agents to evaluate the whole system. In brief, an agent, in this case, is an automated computational model located in a specific environment and interacts with this setting in an automated and effective way. Additionally, a system is modeled in agent-based modeling using a group of decision-making entities called agents. In this case, agents execute the driving of the automated and hybrid vehicles and engineers evaluate how the driver in the simulator operates the car in all terrains [35].

Another peculiar aspect is that an agent is an autonomous computational body positioned in some settings, and which it is capable of ensuring efficient and autonomous interactions with a similar setting. In addition, advanced characteristics and abilities are assigned to the agent are its social ability, proactive behavior and mobility. Depending on its requirement and concrete scenarios, agents are designed with distinct levels of sophistication and complexity [36]. If the general system incorporates a set of loosely attached agents that are embedded in the similar environment, a multi-agent system is created.

Correspondingly, human-in-the-loop is a model that needs individual interaction. It is associated with virtual modeling and simulations in the constructive, live and virtual categorization [37]. Agent-based human-in-the-loop simulations conforms to human factors requirements. Individuals are always a part of the replication; meanwhile, they influence the outcome such that is becomes difficult to reproduce precisely [38]. In addition, it allows for identification of issues and requirements that cannot be identified by other methods of reproduction if there is a proper arrangement to manage the simulation process.

Alternatively, agent-based human-in-the-loop enables the users to transform the outcome of a process or event. The system is effective for training proposes since it helps the trainee to engage as a part of the process, which contributes to a positive transmission of acquired ideas and skills into the real world. At the same time, the trainee utilizes driving simulators in a preparation to become successful drivers. Furthermore, users acquire knowledge on how the new process will affect an event [26, 39]. Its utilization will enable Electrical Vehicle users interact with realistic models and try to operate as they would in the real situations.

What is important is that the agents have to be active and proactive; hence, it requires human social behavior to be included. The capabilities of learning new things and mobility can also be a part of the system if possible [40]. Agents can endeavor to be capable of evolving, which allows the development of unforeseen behaviors. Else, the model describes the system from its units rather than the technology that the structure uses. Undeniably, the mentioned modeling has the advantage in that it describes the natural behavior of a similar coordination. Furthermore, emerging issues captured as interactions in the system of individual entities can occur and these can be solved [41].

Agents are incorporated in the system by being evaluated how they perform the task in real life to be incorporated into that model. The framework which is integrated into the application of human-in-the-loop simulation uses three primary concepts including a motion platform simulator, environmental and vehicle software, and driver monitoring devices in the experimental setup. Used vehicles are electrical cars [21, 43]. A Force Dynamics 401CR platform simulator is used under the motion platform simulator. This platform consists of the control computer and the gaming computer to control the movement of the simulator while the program is running the software [44].

2.2. Instructive Human-In-The-Loop Controlling

This composed work is an instructive based idea as robotic control agent-based human-in-the-loop is an energizing and high test look into technologies work. Sensor is a critical part in robotics. Sensors are utilized to decide the present condition of the framework. Robotic applications require sensors with high degrees of repeat-ability, exactness and unwavering quality. Flex sensor is such a gadget, which fulfill the underlined task with an incredible level of precision. The pick and place operation of the robotics arm can be productively controlled utilizing micro controller programing [45]. The sensor that recognizes the point of the fingers has been appeared to give high exactness albeit modest in the present research. In addition, by entering the sensor information away from any detectable hindrance source interface by the Blender 3D program, is can see how that the human hand moves.

Lately, human-in-the-loop control has been widely used in many research projects [34, 46]. These projects in general consider how hardware, software and humans can work together in a joint environment [6]. Notwithstanding, testing these calculations and setting up tests are frequently troublesome because of security concerns and the absence of reasonable models. In this study, the points of interest of a human fingers development, are displayed to address this issue, concentrating on motion tests. All code alluded to in this work is expected to run the product, the extra sensors, and the essential handling is accessible for utilize [47].

This rendition of hand is the consequence of a great many years of evolution and adjustment. It has 34 sets of muscles, which move the fingers and thumb. The point is to plan a virtual reality hand that is essentially a virtual human hands as we designed by the Blender 3D program with 5 fingers that gives the capacity to get a handle on the question of different shapes which will be commonly controlled by another human hand with a separation as a human-in-the-loop [48].

The 3D hand will dependably duplicate my hand developments and as agent-based we can design a mechanical hand if we want. This kind of framework is extremely critical in fields of therapeutic, protection and mechanical works where the fragile and perilous assignment should be possible from a separation without really touching it. The principle refinement of the framework is that the angle resistance relationship is gotten with the flexible sensor for the discovery of the human fingertip angle. It can be seen what the human hand is observing at the same time on the 3D Blender interface [38]. This gadget can be utilized effectively in the fields, industry, and defense industry inferable from technological advancements. Specifically, it can be utilized as a part of unsafe helpful works for human wellbeing and security, for example, bomb transfer, private research center operations. Moreover, on account of that the framework is alluring as far as cost, it will empower the development of business simulated robotic hand [49].

2.2.1. Flex Sensor

Flex sensor is also called as a twist sensor, because this sensor is equipped for detecting any sort of moment twist in its structure. This sensor is planned in a thin plastic strip sort material with carbon particles layered on one of its surface [34]. This carbon layer is separated into little segments and associated together in arrangement by the conductive layer, as shown in figure 2.2.

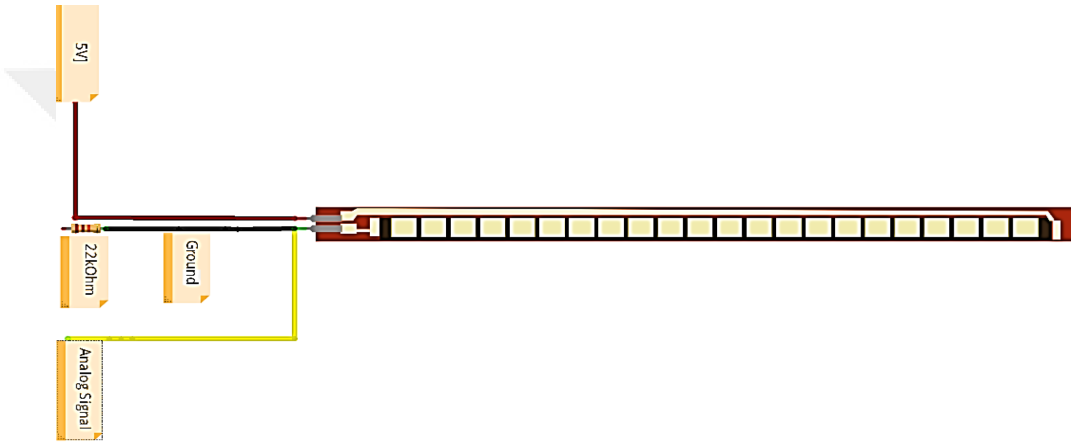

Figure 2.2. Flex sensor design.

The Flex Sensor, is a licensed innovation which depends on resistive carbon components. As a variable printed resistor, the Flex Sensor accomplishes awesome frame factor on a thin adaptable substrate. At the point when the substrate is twisted, the sensor delivers a protection yield associated to the curvature radius. The smaller the range, the higher the impedance value [50].

Spectra character has utilized this technology in providing Flex Sensors for the Nintendo Power Glove, the P5 gaming glove. There are also utilizations of flex sensors in car controls, therapeutic gadgets, mechanical controls, computer peripherals, wellness items, melodic instruments, measuring gadgets, virtual reality diversions, consumer production, and corporeal treatment [51].

Spectra-sign-designers can change the real ostensible impedance of the Flex Sensors according to gathering customer needs. The quality of flex sensors is specially crafted to coordinate client specs, abnormal state of unwavering quality, consistency, repeatability, cruel temperature impedance, assortment of adaptable or stationary surfaces for mounting, and unending number of protection conceivable outcomes and twist proportions [52].

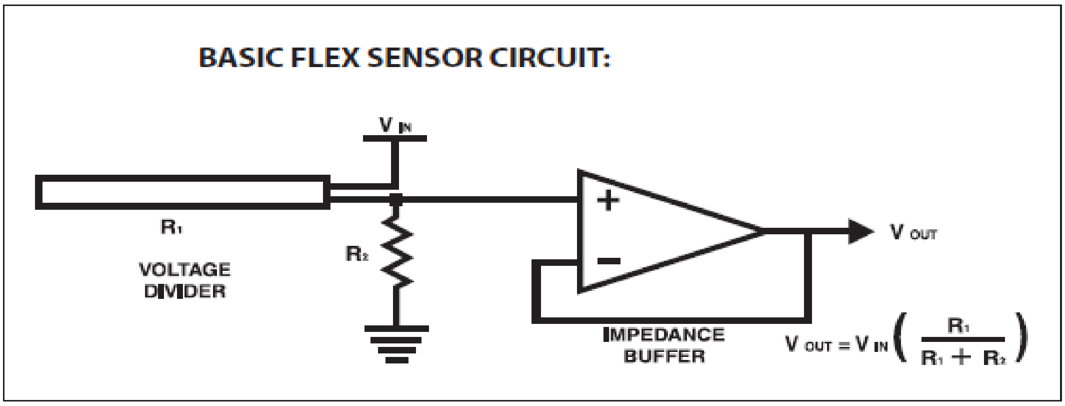

Figure 2.3. Basic flex sensor circuit [53].

The impedance dielectric in the [Basic Flex Sensor Circuit] as shown in the figure 2.3. on top of is a solitary sided operational speaker, utilized with these sensors on the grounds that the low inclination current of the operation amp lessens blunder because of source impedance of the flex sensor as voltage divider [53].

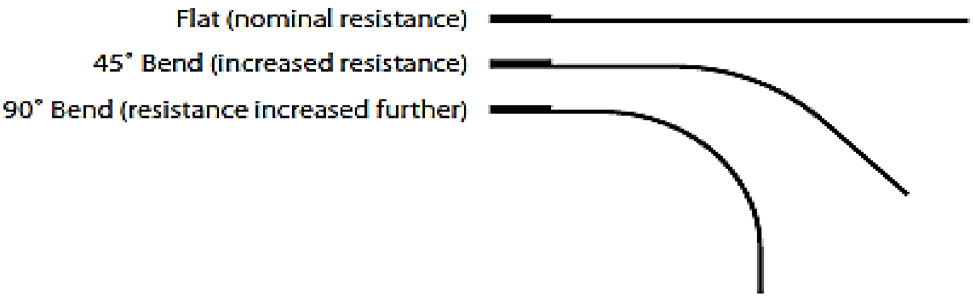

Figure 2.4. How the flex sensors work [53].

In figure 2.4. we show how the flex sensors work in each situations, Flex sensors are analog resistors; they labor as voltage dividers. There are carbon resistive components inside a thin adaptable substrate inside of the flex sensor. More carbon implies less impedance, when the substrate is twisted the sensor creates an impedance yield in respect to the curvature radius [42]. Temperature range of the flex sensors is between (-35°C to +80°C).

2.2.2. System Design

In this section, we will be utilizing flex sensor (twist sensors) to detect the movement of our fingers. We will be utilizing 5 sensors that will be organized in a hand glove (right hand in underneath fig) which will make the sensors agreeable to wear. The other part of the 3D hand model will comprise of 5 fingers that will be controlled utilizing Python code. All together it will be a hand comprising of 5 flex sensors in each finger. Bend of fingers is investigated utilizing one of the Arduino-mega microcontrollers and this information will be sent to Blender 3D program through serial communication. Another microcontroller will create proper signals for controlling the 5 finger model. Flexible sensors are mounted onto the glove as appeared in figure 2.5. to cover the whole length of the finger.

Figure 2.5. Flexible sensors which are mounted onto the glove.

The many-sided quality of the project is lessened by appropriately sorting the entire project into sub plan. It improves it make a plan and work viably with our partners. 3D hand model Structure is the key piece of the entire. The human hand is verifiably a work of ponder. This variant of hand is the consequence of a huge number of years of evolution and adjustment. Its format and suite of configuration highlights empower humankind the main owners of this specific game plan of bones, ligaments, muscles, and nerves to sort quicker than 60 words for each moment or swing an overwhelming sledge while holding a sensitive potato chip. It has 34 sets of muscles, which move the fingers and thumb. Plan a 3D hand model structure of hand, which looks recognizable to our hand, is the urgent piece. In figure 2.6. show the demonstration of Flex sensors and Arduino circuit associations.

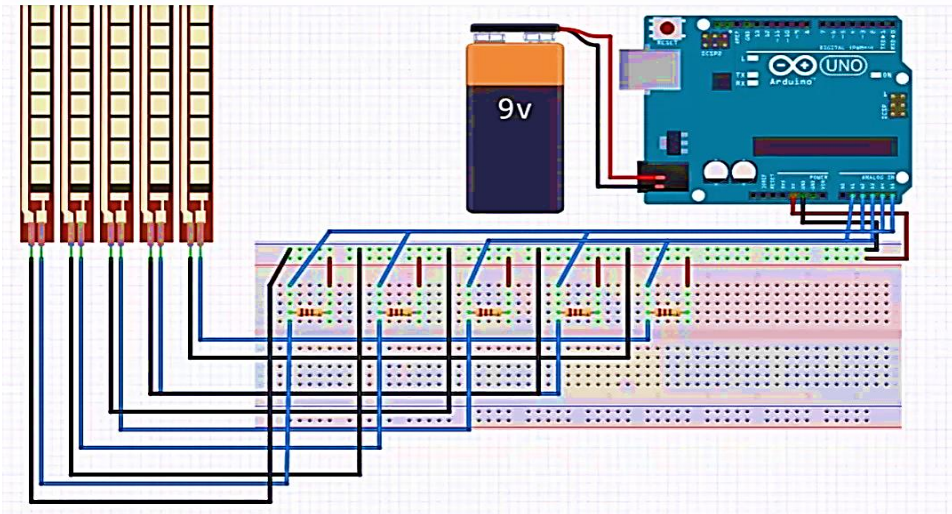

Figure 2.6. Demonstration of flex sensors and Arduino circuit associations.

Sensors are associated with the simple contributions of the microprocessor as per the voltage division standard. Blender 3D program whose favorable circumstances are the open source program and high technics are utilized for designing 3D models developments [28]. The figure 2.7. shown the full window user interface of Blender 3D program.

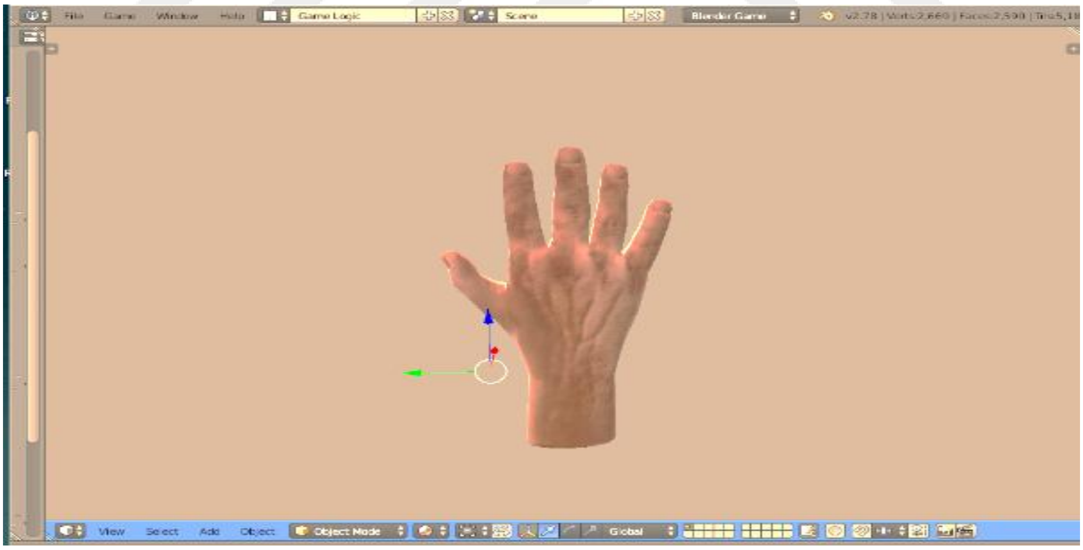

Figure 2.7. Blender 3D full window user interface.

The analog data got from the finger sensors situated in the fingers is converted to angle data in the advanced shape and afterward sent to remote 3D hand model through communication-module.

2.2.3. Working with the Blender 3D and Arduino board

Blender 3D is an open source free 3D modeling and animation application. Notwithstanding being a 3D modeling animation software, it incorporates a diversion motor, a video and sound montage software [29]. With a specific end goal to screen the human hand movement on the PC, the angle information is sent to Blender 3D by means of serial communication and the finger developments are checked momentarily. Similarly, continuous amusement control is given through the interface that imitates finger developments, and the animation should be possible for the PC.

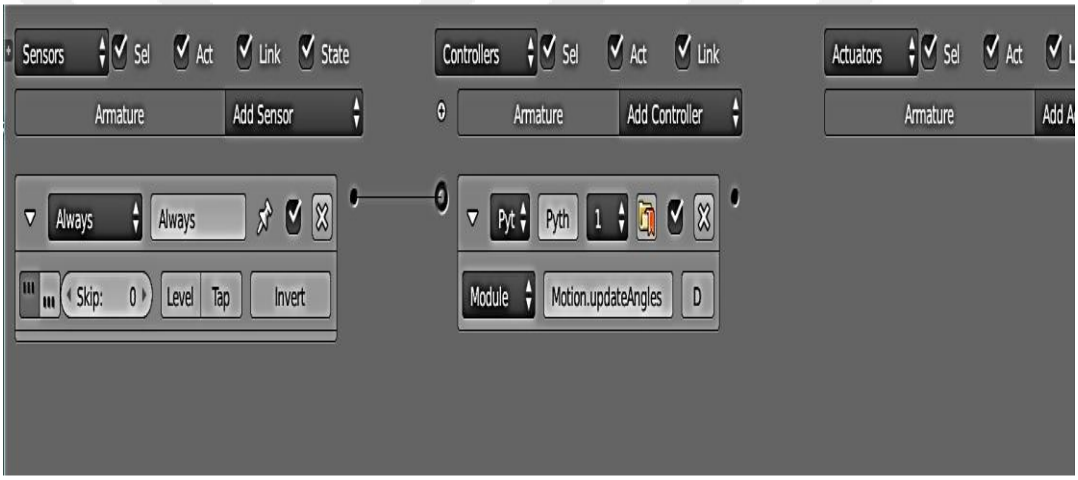

Figure 2.8. The relationship between sensors and controller in Blender 3D.

The Arduino boards are open source microprocessors that utilize a very simple C based language [30]. Sensors and transducers can be connected to the boards and programs downloaded onto the board's memory can process the signals. In this case the Arduino is used to read the value over a potentiometer, it sends this value via serial-USB to 'Processing' which sends the value to a port. A Blender 3D game is set up to receive the value. The data can be picked up or sent to a number of different ports which allow new levels of user interaction with the 3D hand model. For instance, a flex sensor value could be mapped to control the motion of a human hand. In the figure 2.8. we are shows the relationship window between sensors and controller in Blender 3D.

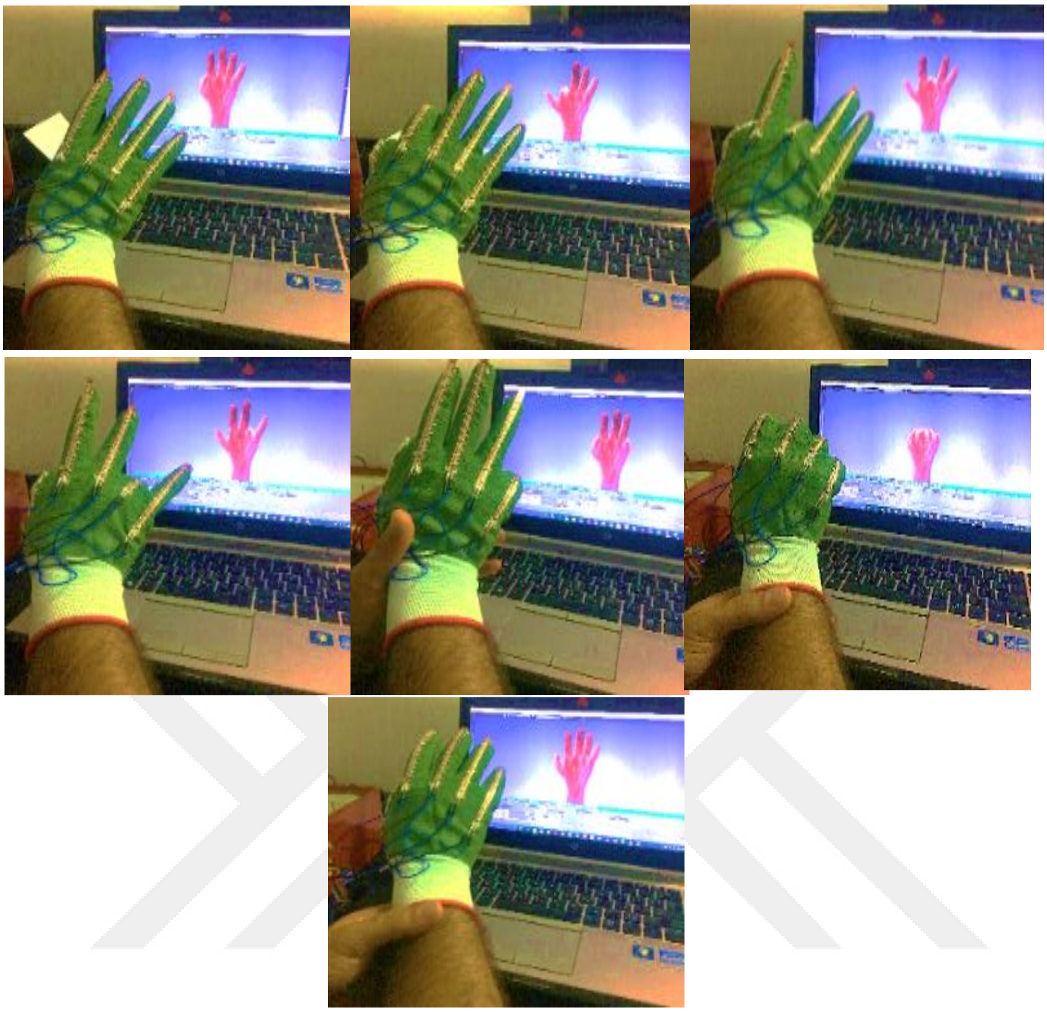

Figure 2.9. The motion of fingers with the Blender 3D Program.

Results as shown in the figure 2.9. motion of finger with the Blender 3D program, that we get human hand glove with flex-sensor when fingers movement, accomplish hand of Blender 3D model at same time. This method makes motion process more close to real time condition, and the whole motion process is accomplished in safe environment, which would help designer to save more time. It’s very important in initial design state of hand motion control system.

Table 2.1. Result of finger movements with flex-sensor.

Finger	Finger movement angle	Output Data of the movement
Thumb	90° 180° 270°	10020 7600 5200
Index	90° 180° 270°	11775 8320 5349
Middle	90° 180° 270°	11786 8384 5451
Ring	90° 180° 270°	11054 8357 5367
Pinky	90° 180° 270°	11028 8296 5223

Table 2.1. shows results for the motion finger case, where moving each finger with each angle will change the output in the software. Agents are essentially allowed finger motion, so that learn policies with this behavior. It is important to note that changing the underlying movement would not simple be enough to encourage software behavior.

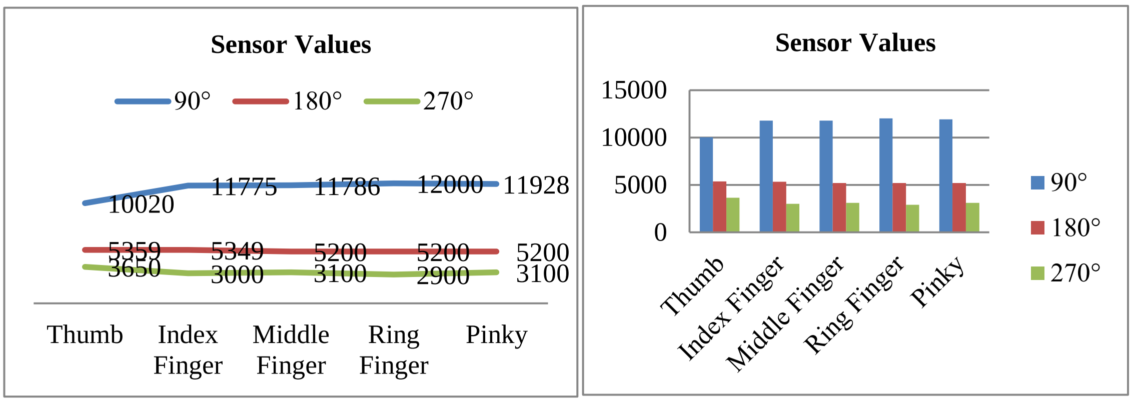

Figure 2.10. The finger motion and the output data of sensor.

Figure 2.10. shows the sensor values and the output data for each situation of finger motions, when we moved our fingers by each angles the flex sensor send the signals and converted it to output data to show us for this situation the output data it will be like this as shown the chart in the figure 2.10.

The Glove Hand with Flex sensors are extremely valuable for general public. It also works effectively at the season of exhibition. In future, it will take a work on wireless technology. In this framework, it has been kept that finger developments are seen and imitated with high exactness with no issues on account of the flexible sensors mounted on any glove. The oddity of the framework is that the framework can be observed on Blender 3D model [31, 32]. With Blender 3D interface, the glove can track the position of the hand developments. Because of the connection, development that is more agreeable is conceivable and the use territory is extended. Since the flex sensor has high current in the beginning, the provisions are made independently. The framework is conceivable the robot hand will turn out to be economically more far reaching since it is minimal effort. It can be likewise utilized as a part of cautious industry, in bomb transfer works, in dangerous places regarding human wellbeing and security, in animatronic works, in individuals who are living with distress during childbirth or later on their fingers. In the following investigation, wrist developments with flex sensors are likewise incorporated into the examination, and furthermore EEG (Electroencephalograph) signals are utilized to control thought control [43].

3. THE PROPOSED APPROACH

Exactness of physical models at different levels are important for EV improvement. We'll require models that have less detail however simulate quick, for example relationship in engine and generators, and different circumstances will what simulate the whole three phase in electrical system, so by then will utilize more point by point models and incorporates exchanging progression the capacity to adjust the exchange off between show precision and simulation speed is basic for productive advancement.

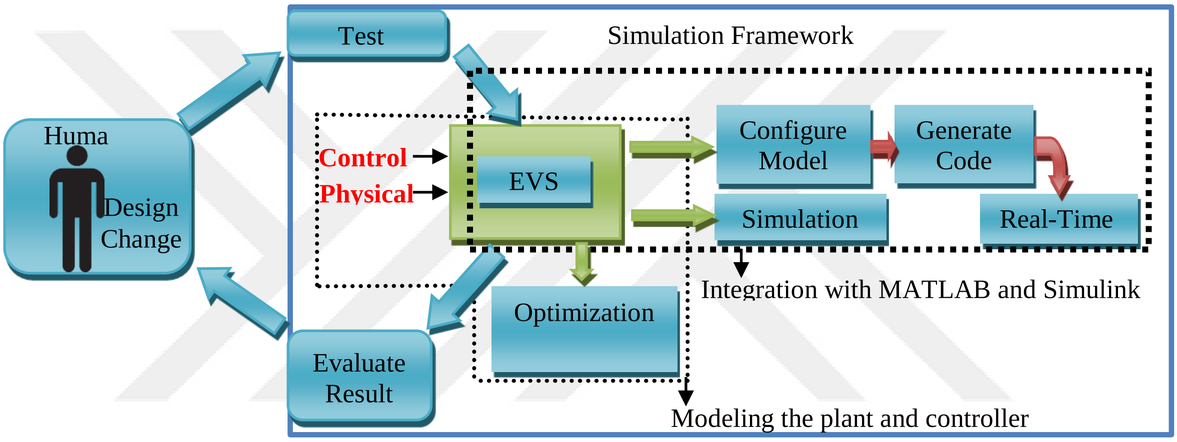

Figure 3.1. The block diagram of the proposed approach.

In the figure 3.1. shows the block diagram of proposed approach which is consist of four parts human activity designing changes for each iterations, testing design, simulation framework which is: physical component models at various levels are necessary for EV development (need models that have less detail but simulate fast), modelling the plant and controller in a single environment enables system level optimization, integration with MATLAB and Simulink enable efficient development post processing and deployment, and finally evaluate the result.

Demonstrating the plant and controller in a solitary environment empowers system level improvement. Packaging the planting controlling in a single environment empower system level advancement the model that we are working with predictable the physical framework and the control system in a solitary situation in light of the fact that if this will have the capacity to enhance system level execution and we'll see a show how parallel computing can quicken this procedure.

Combination with MATLAB and Simulink empower effective advancement post handling and sending. We will perceive how we can naturally report the consequences of our tests and we will perceive how we can create C code from the model for sending on to a hardware in the loop framework.

3.1. Electrical Vehicle Systems

Initially, electrical vehicle systems (EVS) was developed in order to help and overcome the limitations of battery-powered electric vehicles (BEV) as well as internal combustion engines (ICE). EVS systems unite conventional propulsion with an electric machine and electrical energy storage systems. Indeed, it becomes important that once EVS are enhanced in the electric form, it obtains zero emissions. The systems demonstrate improved economy when compared to conventional internal combustion engines. Additionally, these structures tend to enhance a longer driving range compared to battery-powered electric vehicles [44, 46]. The EVS can help to eliminate the problems related to pollution and energy crisis.

Nevertheless, it is important to note that the mentioned systems are expensive; hence, they are limited in their distribution. The success of the first cars, such as Toyota Prius, is an indication that EVS vehicles are an alternative solution to ice vehicles. Furthermore, the United States market trends prove that P- EVs are becoming the attractive and hopeful solution. EV systems are propelled by two power strains [45]. The ICE provides the electrical vehicle with an extended driving range, while the electric machine (EM) increases the fuel economy and the efficiency by regenerating energy during braking and storing the surplus energy produced, and in the figure 3.2. shown the main components of an Electrical Vehicle systems.

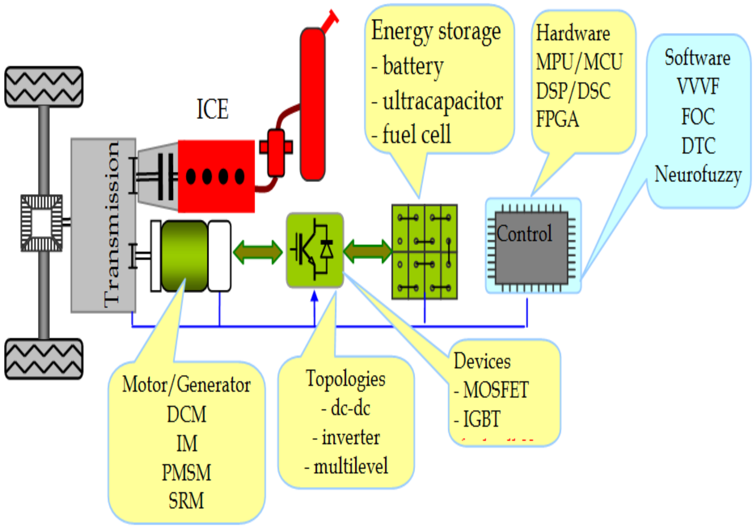

Figure 3.2. The main components of an electric vehicle [45].

There are different EVs architectures depending on the manner in which the two powertrains are combined. The series- parallel electrical system with a planetary gear stem have a maximal number of subsystems which allows parallel and series operations [44]. Consequently, the choice of this architecture is effective for the basis of comparison and discussion in this thesis. The electric machine and the transmission shaft are connected to the planetary gear set, whereas the ICE is connected to the carrier [47]. Furthermore, the second electric machine is joined to the sun gear. This structure is shown in such a way that it allows other traditional architectures to be deduced.

Moreover, by the use of the planetary gear set and the dc voltage bus, series parallel EV can work as either parallel EV or series EV in terms of energy flow. Furthermore, the energy node can be located in either electric or mechanical coupling components. Due to planetary gear, the ICE speed is a weighted average of the speeds of both electric machines. The speed of the first EM is proportional to the vehicle speed while the second EM. Series- parallel and EVS require planetary gear set and three motors, which makes the power strain expensive and complicated [48]. Essentially, controlling and managing this system is complex. In concentric machines and planetary gear set, the speed ratio between the transmission and ICE shaft is variable and continuous.

Alternatively, the BEVs are evident when only the electric machine (EM1) power-strain tends to be apparent effect of the series- parallel structure. Since the batteries are the force to propel the vehicle, zero emission can be achieved. Nonetheless short driving range, high initial costs of BEVs and long fueling time has limited their use [49]. There is the need for new BEV structures that use various energy sources, for example, reduced power fuel cells, batteries and super capacitors that are linked to an identical DC bus. Consequently, this will reduce the duration required when fueling, drive own price, as well as expand the driving range. When it comes to the fully electric traction system, it means that electric motor can ensure the propulsion of the automobile. At the same time, by the use of fully electric system, there is no pollution, Zero Emission Vehicle (ZEV), and that these models can be used in urban centers for safety issues [50]. Nevertheless, the evident propulsion can also be managed by the combination of ICE and EM. With the use of EVs the fuel economy is estimated to improve.

3.2. Improved Algorithm Implementation and Performance Verification

Various algorithms are used to ensure the effectiveness of human in the loop systems [54]. The Hierarchical algorithm is effective in making a context-aware system and incorporating the different factors involved, for example, as the driver mode. Similarly, this framework is classified into attentive, partially attentive, and distracted one [55]. The simulator setup includes components, such as motion capture system, sensor network, used for dynamic human modelling, wheel touch sensor and camera and Microsoft Kinect 2. A phone application was also included in the setup [56]. Therefore, the set of connections is able to monitor driver’s pose in the real time, his or her exact gaze, driver’s state using the video processing algorithms, if a driver is holding the wheel, as well as the distraction that occurs after using the phone [54].

Indeed, the algorithms used in the human-in-the-loop simulations are useful to give the driver’s state and they help in designing an effective final model. Actually, these components are important in creating predictive sets by dividing the data into the various groups depending on their relationship to one another. For example, data on the driver’s state is related to the posture of the car on the way and the steadiness of the vehicle [56]. Empirical probability distributions of the trajectories that can happen can hence be predicted. In addition, simulation results clearly show that the agent-based control framework is effective to combine the various energy sources and manage the power/voltage profiles [57].

Many companies including BAE systems engineers have sophisticated human-in-the-loop simulation capacity to help in designing hybrid electric drove systems for prospect vehicles [58]. For more than two decades, the company has been utilizing simulation and modelling capabilities to develop and incorporate the combat vehicles and technology. The technology uses physical based models in real time. Consequently, the engineers are able to examine how a vehicle responds as a simulator operates the car, especially on a terrain environment. Agent-based human in the loop simulation will enable future vehicles to be precisely optimized and evaluated in a pragmatic environment before a hardware prototype is developed [59].

Significantly, development of the mentioned capability will be applied in designing Electrical Vehicle systems. Furthermore, a corresponding ability provides the users with the information similar top operational activity and allows pliability in designing subsystems and vehicles. The human on the loop environment is critical in examining design notions in a so short time, and allow manufacturers to sustain cost and obtain new prototype on schedule, as shown in the figure 3.3. the control algorithm box is filled to verify any developed algorithms or ignored for pure data collection. Agent-based human on the loop gives easy access to engineering and design information for the purpose of optimizing hybrid and autonomous vehicle systems [45].

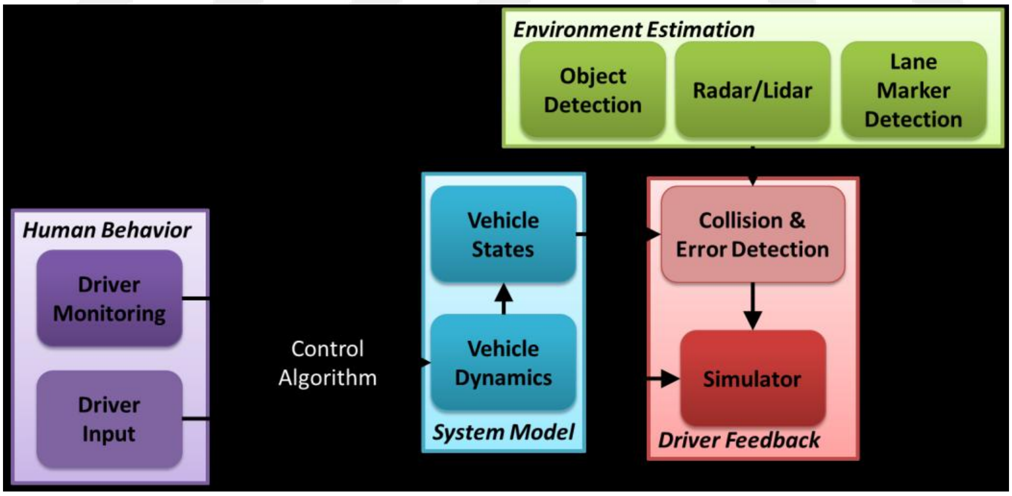

Figure 3.3. The modular component setup. the control algorithm box is filled to verify any developed algorithms or ignored for pure data collection [45].

3.3. Method

The driver model is calculated using the following mathematical formulae:

$$\theta: O \times I \rightarrow Q \tag{3.1}$$

in the equation (3.1), The O refers to the past observed information of the driver. Additionally, the I is the information at the current time while Q is the set of discrete mental states that the driver can be in at a certain time. Based on the work states on psychology and discrete event systems, the tasks can be low, high or none [61]. In the same manner, one's own state can distract, partially attentive or attentive. The equation is also based on the fact that the behaviour portrayed by a driver is related to the state of mind and the context. However, various uncertainties occur while one is driving in the different terrains of the different environments. Eventually, the vehicle has many potential future states. To incorporate these uncertainties, the following equation is used.

$$\Delta \subset Rn\ |\Delta| \text{ subj. to } P\theta\ (O, I)\ [(X\ (k) - x0) \subset \Delta|O, I] \geq \alpha\ \forall k \in \{0, ..., N\} \tag{3.2}$$

In the equation (3.2), X is the random trajectory that is used to determine the future vehicle trajectories, $x0 \in Rn$ represents the initial position, N denotes the time horizon, $P\theta$ is the distribution estimated of the trajectories depending on the driver state and the information sets, Δ is the value of the minimum area set which contains the future trajectory that the vehicle is likely to make using the least probability as $\alpha \in [0, 1]$. The interpretation can also be the α-possibly reachable positions of the vehicle using the past and the current data that has been observed from the driver. The optimization program's output at can be determined at the time k to give a probability distribution defined as Δk (O, I, α).

The algorithm used reduces the making of assumptions about the human behaviour. An empirical distribution is thus used and is determined from the observed information. The information is linked to the various observed environments. Some actions such as the braking system are most likely to occur in the event of a red traffic light. The algorithm used here calculates the amount of force to be distributed to the car brakes depending on the situation. An emergency situation, for example, requires more force in the brakes and is supposed to make sure the car remains on the road. The bond graph modelling is efficient in determining the physical concepts that involve the car. The analysis of this model is combined with various adjustments to result in a human in the loop simulator for six degrees of freedom.

An active hybridization technique is supposed to be used in electrical vehicles to combine power sources effectively. The various power sources are the cells, batteries, and super-capacitors. The bulk power system is used to make the autonomous distributed energy system. The control strategy also manages the key power source and makes sure that the advantage gotten from the hybrid vehicle is fully utilized (Shafiei et al 1640).

3.4. Electrical Vehicle Model

The model that are working with, has numerous choice for adjusting model precision in simulation speed. The electrical model has a framework level variation, which can use to test for migration issues and advanced if the whole system we likewise have a mean esteem variation where we can perform tests on a three-phase electrical system and we have a point by point variation which incorporates the power hardware with the goal that we can test the power quality on the diverse system electrical system in the electric vehicle for the battery model we have the choice of utilizing non-specific predefined and custom models relying upon which segment of the system are concentrating on, the vehicle model has two unique variations one that incorporate basically a national a streamlined influences it simulates rapidly and afterward we have another variation that incorporates tire models another flow, these alternative to modify the my level up display precision makes is very adaptable in the improvement procedure and empowers is produced to grow proficiently, well additionally observe that the simulation comes about match at the framework level, this empower us to utilize the lower exactness models to repeat all the more immediately, when taking a gander at the electrical framework will see that adding the detail to the model will give us some the choice of doing a significantly more nitty gritty examination of the electrical framework are currently change over to the model with the goal that you can perceive how this is finished.

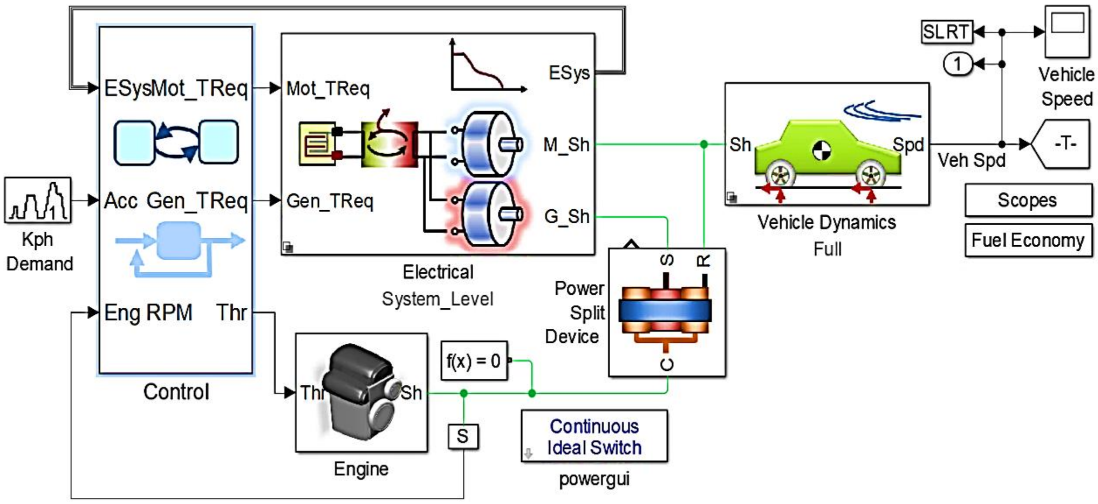

Figure 3.4. The model of electric vehicle system [46].

Here is the model that will work with it's EV with the arrangement parallel design, as shown in the figure 3.4. the model of electric vehicle system, it comprises of a control framework with numerous relative basic controllers and in addition model logic programming state stream we likewise have the mechanical system which comprise of the motor the power spectra bad habit and the vehicle dynamic models and some drive line, electrical system has an engine generator DC-DC convertor and a battery we can switch between the diverse variations utilizing configurable subsystems, so here is the place would choose an alternate battery models and you can see at the electrical level we have the three distinct variations that we portray before Steve framework level mean value in point by point and for the vehicle dynamics the fall and a basic models to test this jug we will utilize a MATLAB script, we will run it through three diverse drive cycles and to see the outcomes you can see here that we are trying this at the framework level, however the straightforward vehicle and the predefined battery and the drive cycle there were trying are appeared and downloaded this drive cycles from the web and these are standard drive cycles that are utilized to test EV, when every one of the three tests are finished will see report that demonstrates the outcomes contrasting the framework results and more definite outcomes simulated utilizing alternate variations of this model, that simulations are running rapidly is a four hundred second simulation and they are running around 10 distinctive around 10 second, where being a would have the capacity to create rapidly with this excited about the framework.

Modelling part of the system, the electrical, battery models some hardware gives a bland battery display it's spoken to as a charge depended voltage source, the benefit of this battery show is that it can be utilized to speak to a wide range of sort of batteries and there are generally couple of parameters that can be effectively found on information sheets, sim Paris Systems gives numerous predefined battery models you can choose them from the pulldown menu and they have full pram enters a shin, the documentation gives broad detail on how these batteries are demonstrated. These pieces are utilized as a part of this framework display by non-specific battery model and some gadgets we have parameterized this model with MATLAB variables, the equation that represents the charge (v = v _nominal*(1 – alpha*(1-x) / (1 –beta*(1-x))) coming from this battery we can switch this using configurable subsystems to look at the predefined model, in the event that I need to perceive how this battery is demonstrated can look in the documentation and you will see broad documentation on the conditions that were utilized and the suppositions that have been made, if these battery models don't address your issues you can make a custom battery display utilizing a Simscape language a typical approach to make a battery show is to make a battery cell identical release circuit, in this circuit will be endless supply of charge and temperature you can make these custom segments utilizing the Simscape language and after that development the model of the battery cell, as shown in the figure 3.5.

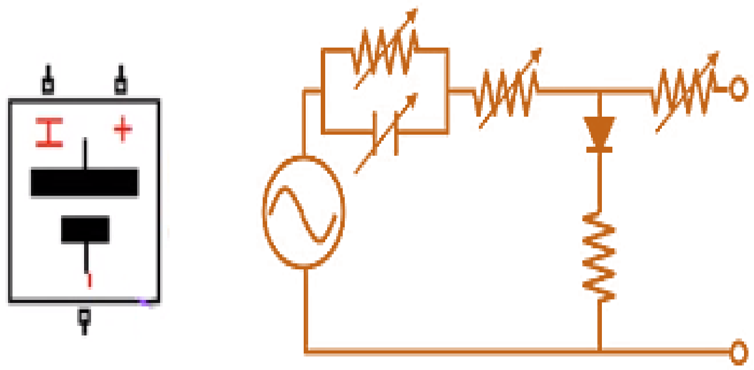

Figure 3.5. Battery cell equivalent of a discharge circuit.

The Simscape language it's based on MATLAB and enabling text-based authoring of physical modelling components, domains, and libraries you can see the source code for an ultra-capacitor, (i = (C_0+ $C_v v$) $\frac{dv}{dt}$ + $\frac{v}{r_d}$) another Chi component that you may discover in the electric vehicle the equations that you may discover in a course book can be actualized in the equations segment again as indicated by that verifiable in include distinctive gathering definition that the key things to recall is that it use MATLAB so on the off chance that you know about MATLAB you will have the capacity to embrace this physical modelling language rapidly its object-oriented for demonstrate reuse you can utilize it to create appearing squares like the ones we saw on show and on the off chance that you have to you can spare this model as a twofold document keeping in mind the end goal to ensure your licensed innovation utilizing these abilities you can develop a custom battery model to address your issues, as shown in the figure 3.6. the block of battery charge controller.

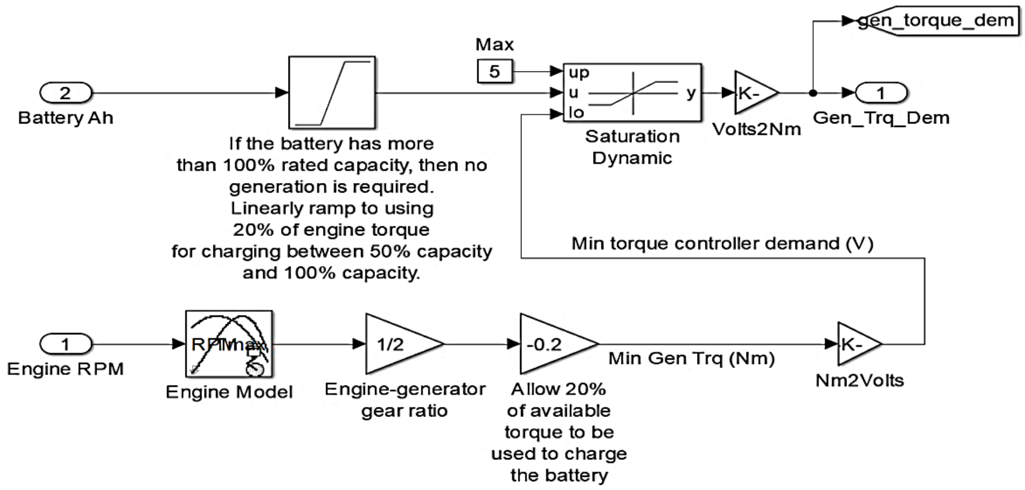

Figure 3.6. Battery charge controller.

Electrical system, the engine and the generator are displayed utilizing some gadgets in some hardware the engines and drivers utilize information sheet parameters, so you can discover those qualities effectively and incorporate torque independent dependent an electrical loss. For control quality examination we joined three-phase machine models from straightforward our frameworks, these incorporate a more point by point parameters Asian a key ability of some power frameworks to accelerate simulation with control hardware is the perfect exchanging algorithm when the perfect exchanging algorithm is utilized sim Paris system, takes a gander at our electrical circuit distinguishes the power electronics and computes the diverse setups the can come about when this which is our opening shut these are then converted into a state space matrix by regarding the switches as perfect and pre computing these configurations, the simulations run significantly speedier we should perceive how these parts were utilized as a part of our general model, electrical system a DC-DC converter is utilized to support the voltage from the battery to 500 vaults required on RDC network that is utilized to drive the engine, the engine in the system level excited about electrical network is demonstrated utilizing some electronics, you can see that a query table has been utilized to determine the connection amongst speed and torque, this empowers this engine model to run amazingly rapidly and these are parameter esteems you ought to have the capacity to discover on a datasheet other parameter esteems accessible here enable us to display the torque free misfortunes and we have parameterized these parameters utilizing MATLAB variables, as shown in the figure 3.7. the DC-DC convertor system.

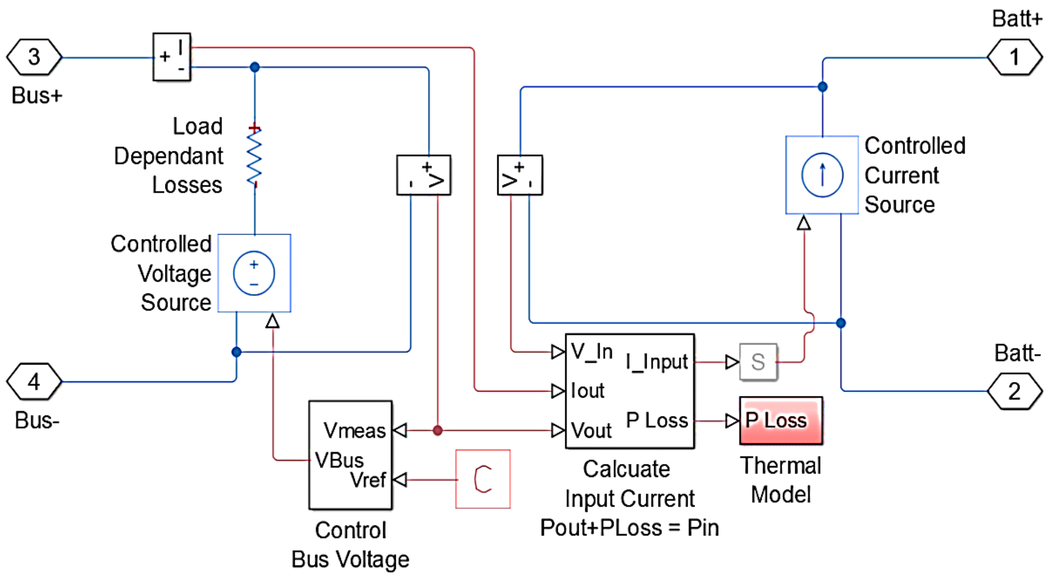

Figure 3.7. DC-DC-Convertor system.

The mechanical driver train is modelled, the power split gadget is displayed as a planetary apparatus utilizing the GUI library since in drive line, you can see a portion of the rigging models that are accessible, the full vehicle model incorporates tire models and longitudinal dynamics, the motor model is a query table relating rate to accessible power, if these models are not adequate for your requirements you can expand them utilizing A Simscape language or Simulink.

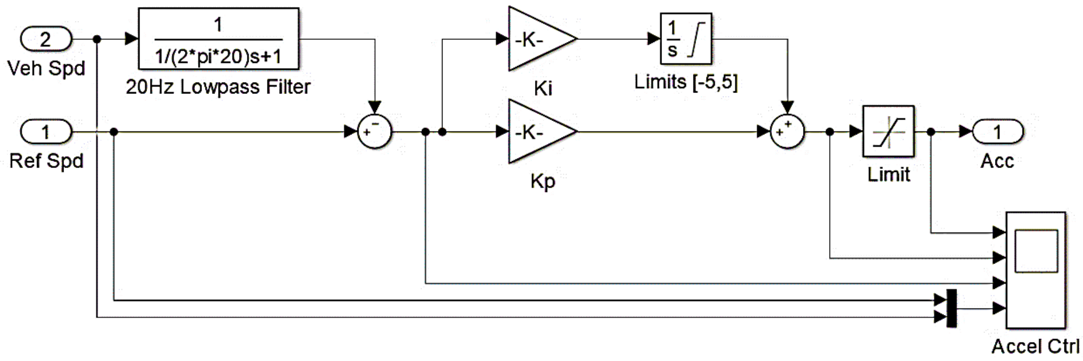

Figure 3.8. Vehicle speed control.

In the figure 3.8. shows, how the models are joined and control vehicle speed, the motor model that the info is a throttle flag originating from my controller mechanical associations associated with the indication of the drivetrain the planetary apparatus is displayed utilizing same drive line: we can see the transporter which is associated with the motor the rain which is associated with the vehicle and the electrical engine and the sandwiches associated with think the generator these mechanical connections connect to the reset to the framework, so change to full vehicle model to perceive how this was demonstrated the tire show the vehicle connect and the differential for connecting these two axles, so the front pivot and takes after Rep speaks to the back hub, that is use at the framework level.

4. SIMULATION RESULTS

The researchers have developed a new electrical vehicle simulator which allow us to simulate the behaviour of one or more communicating on the surface vehicle in the poor terrain environment. In addition, it performs agent based human-in-the-loop simulations such as virtual sensing to help in sensing the virtual environment. During simulation procedure, the simulator is connected to the electric machine so that all computational associated with environmental mapping and vehicles control achieved by the embedded computer. Before experimentation, we have tested various parameters related to the simulator. Furthermore, the obtained experimental results discussed are inconsistent with those obtained with the simulator. Thirteen subjects, there female ten males between the age of 24 and 40 were recruited to test the forecast algorithm for intersection and highway scenarios. The driving experience ranged from 2 to 16 years. for the highway scenario, subjects were requested to drive on 5 courses each lasting for 15 minutes to generate four training and one test set using prescan to run on the simulator (Tweedale 192). It consisted of two lane roads with turns of different curvatures, which has different levels of traffic to be moved to independently of other vehicles with no opposing traffic.

Equally important is the fact that drivers experience several obstacles including trailers and cardboards on the road. Furthermore, the drivers are asked to drive in the same way they drive normally. The final test incorporated of barriers and road patterns with no experience in the training to confirm flexibility of simulation model. Moreover, the driver is provided with an android phone with customized application aimed at randomly chink the driver to respond to the text messages 50s later after he or she responded to the previous test so as to stimulate distraction. There is also application of recorded phone acceleration used to determine whether a driver state is in the real time. The evaluation of agent-based human-in-the-loop model is presented using metrics. A similar association between accuracy and precision is obtained. The accuracy from this experiment is required since the driver’s behaviours are observed to be consistent in the event that spontaneous actions are likely to occur.

The experiment proves that the accuracy decreases over time just as expected. The outcome is partially explicated by the uncertainty of the environment, which can change drastically within as short period of time. Furthermore, the accuracy decreases as a function of clusters numbers, and the precision is lost if the researchers ignore the environment. Therefore, for useful prediction, the environment element must be considered. The formulation helps to examine the control aspect of human behaviour when driving. Using drivers' inputs in the car, we establish an empirical probability distribution to consider the drivers' actions in terms of control. Consequently, we are able to understand how human behaved and controls the vehicle in distinct driver modes. Since the researchers are straight perceiving the human behaviour and producing the borders based on them, the expected collections are not always smooth, but accurate and factually.

4.1. System Mod Logic

System Mode Rationale, the particular for the mod logical electric vehicle, when the vehicle is in movement possibly in begin mod, in begin mod the generator is utilized as a starter engine to begin the motor and the electrical engines used to drive the vehicle when the motor gets over a specific edge the vehicle enters ordinary mod where the motor is utilized to drive the vehicle and to charge the battery if the driver wishes to quicken the engine can used to the vehicle significantly speedier and a generator is killed with the goal that the majority of the motor's toque can be utilized to quicken the vehicle when the vehicle is in journey mode the generator might be utilized to charge the battery, they are additionally changes to back pedal to increasing speed mod and to begin mode, if the driver applies the brakes the engine is utilized, we ever genitive breaking to charge the battery, so this is a case of the determination for the mod logic as shown in the figure 4.1.

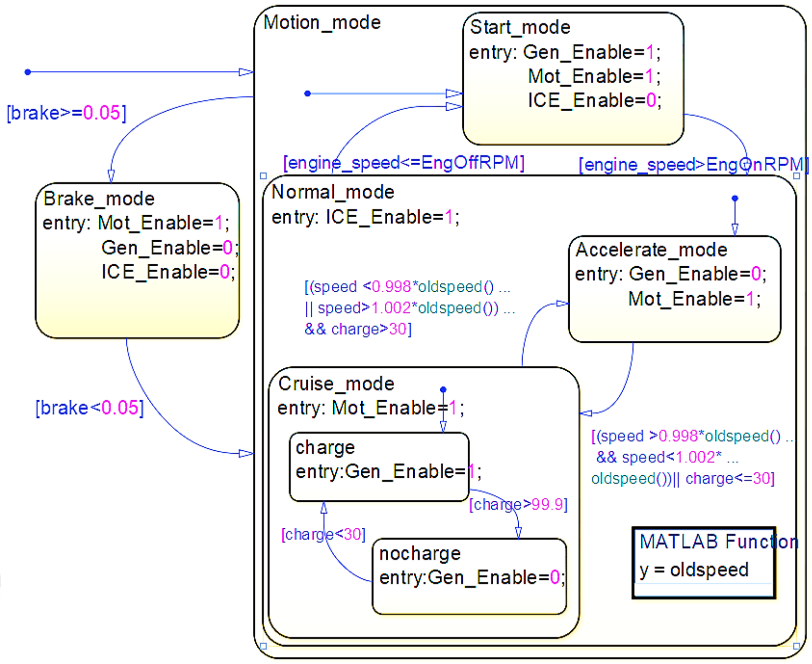

Figure 4.1. The mode logic control.

4.2. Simulation

Simulation and post preparing errands, including parallel computing report age and power quality investigation. In Simulink you can utilize streamlining algorithms to naturally tune parameter esteems, for instance you would them be able to coordinate reaction on the off chance that you have estimation information for to file your engine you can utilize improvement algorithms to tune the parameters, have your engine display until the point that the simulation results match that estimation information you can likewise utilize it to me necessities on the off chance that you know the limits for the progression reaction have your engine you can determine the limits are that progression reaction and afterward utilize enhancement algorithms to tune the parameter esteems until the point when the reaction exists in those limits this is an especially capable ability when connected to the entire framework and this is essential for electric vehicles in this model for example we have parameters for the control framework and also the physical framework we can set up an advancement challenges a hundred diverse drive cycles and ascertains the cost feeling that data to an enhancement algorithm will enable us to locate an ideal set up our parameters that upgrade framework execution this is superior to upgrading the individual segments far will permit, the figure 4.2. shows the moto torque per time for a driving cycle.

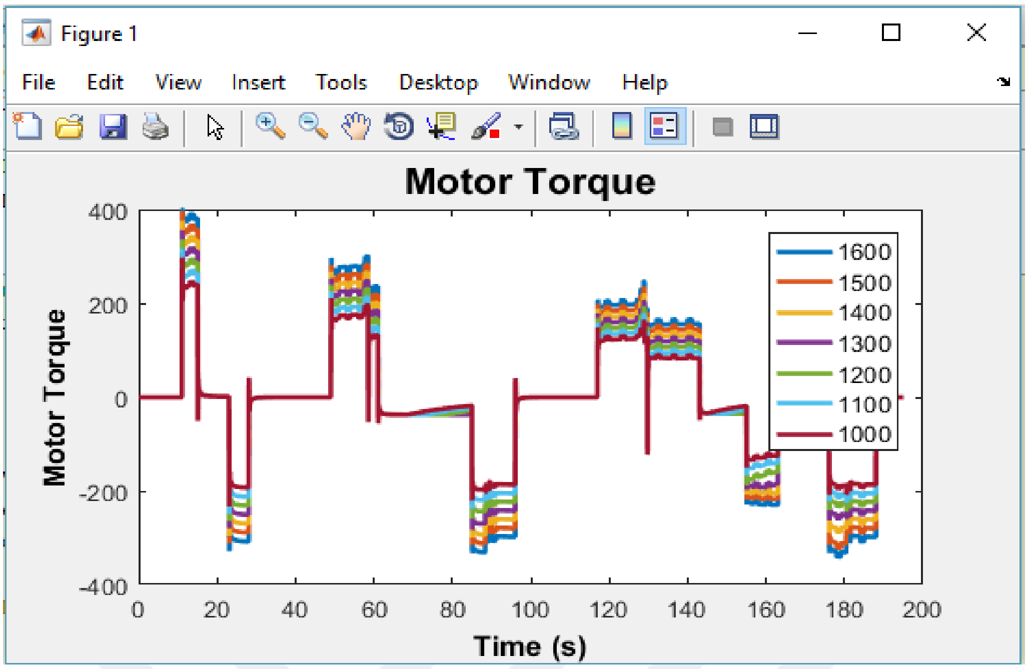

Figure 4.2. Motor torque for a driving cycle.

Developing an electric vehicle will include a great deal of simulations a vital capacity to have with a specific end goal to quicken your improvement procedure is the capacity, to convey those simulations to both of you diverse centers are PCs in Simulink it is conceivable to disperse your simulations to various centers are processors, this can bring about sensational accelerate for simulations, for example doing pram a breadths drive cycles advancements and different sorts of tests you can take your model set up the simulations and appropriate them to various centers on single machine, or you can disseminate them to numerous machines in a PC bunch and doing this can be as straightforward as charging a Matlab script from a for circle to a standard for circle.

Abbreviate simulation times with parallel computing, the model that we are working with its electric vehicle with the arrangement parallel architecture, we need to run a parameter clear parameters in the model, in any case we need to limit the measure of time it takes to run this parameter clear, to do this, utilize the Parallel Computing Toolbox to accelerate the breadth create an arrangement of parameters allowed to the simulation keeps running with, at that point going to circulate the simulation hurried to the two centers on my double center machine toward the finish of the simulation will be to plot those outcomes and will see that when executed in parallel it requires less time.

4.3. Result

When developing a system as complicated as an electric vehicle, much emphasis is required a designer thinks of an outline change arranges an arrangement of tests to test their change runs them gathers the outcomes and after that in view of that surfaces with another thought for configuration change in this cycle a league the means take the longest and now the most inclined to mistake, so what we need to do is figure out how to make making and assessing those tests comes about go quicker, so we can accelerate the procedure of cycle, to do this we will utilize the Simulink report generator to consequently set up the tests run them and record the outcomes. Take an electric vehicle model and design the simulations utilizing them Simulink report generator, going to incorporate plots and results screenshots and MATLAB code into a record this will all be done automatically.

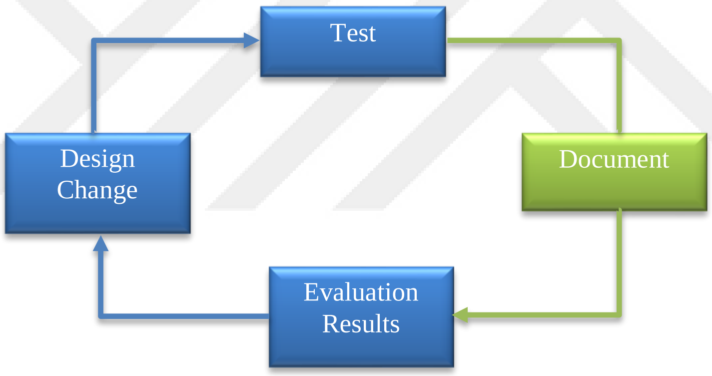

Figure 4.3. Block diagram of the driving cycle loop for the electric vehicle model.

In this block diagram in the figure 4.3. we are show how automatically run tests and document results. When developing a system is complicated as an electric vehicle much iteration is required an engineer comes up with a design change configures a set of tests to test that change runs them collects the results and then based on that comes up with a new idea for design change in this cycle of iteration these steps take the longest and are the most prone to error. We want to do is find a way to make creating and evaluating those text results go faster, we can speed up process iterations to do this we use the Simulink report generator to automatically setup the tests run them and document results.

We take an electric vehicle model and configure the simulations using the Simulink report generator include plots and results, screenshots and MATLAB code into a document this will all be done automatically.

To perform control quality experiments, we utilize the simulation to explore the power quality of the electrical network in an electric vehicle. The model we are working with is an electric vehicle with a parallel architecture. We have a DC electrical system connected to the battery to a crease the engine and the generator on the off chance that we plot. The voltage of the DC electrical system is the important thing that we can observe the power quality of the DC organize is poor in the beginning of this ten-second drive cycle. We need to be sure that the power nature of the DC electrical system is feasible enough for poor power quality can bring about breakdowns blames over the segments and untimely disappointment, so we will utilize simulation to explore the power nature of the DC transport, and in the figure 4.4. shows the result of current obtained from urban cycle.

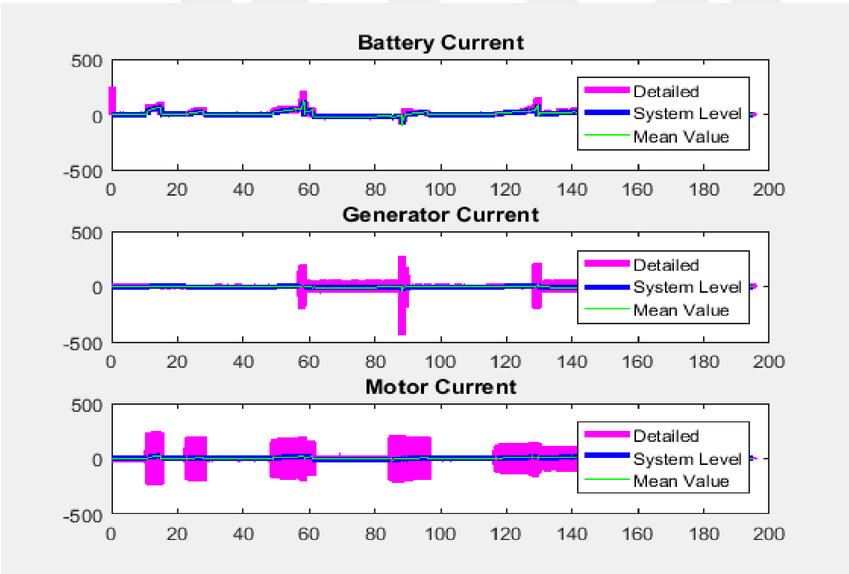

Figure 4.4. Currents obtained from urban driving cycle.

To do this utilization in control frameworks to display the electrical system and Signal Processing Toolbox to analyses the power quality, electrical system is demonstrated utilizing power frameworks we have generator and the engine that are both connected with the DC transport with control gadgets. In the three phase inverter utilizing spectrogram from the Signal Processing Toolbox we can make a spectrogram at the DC transport this gives us a sign under power quality from the DC transport and can be utilized to make sense of which segments are adding to low quality on the transport, the figure 4.5. shows voltages gathered from urban cycle.

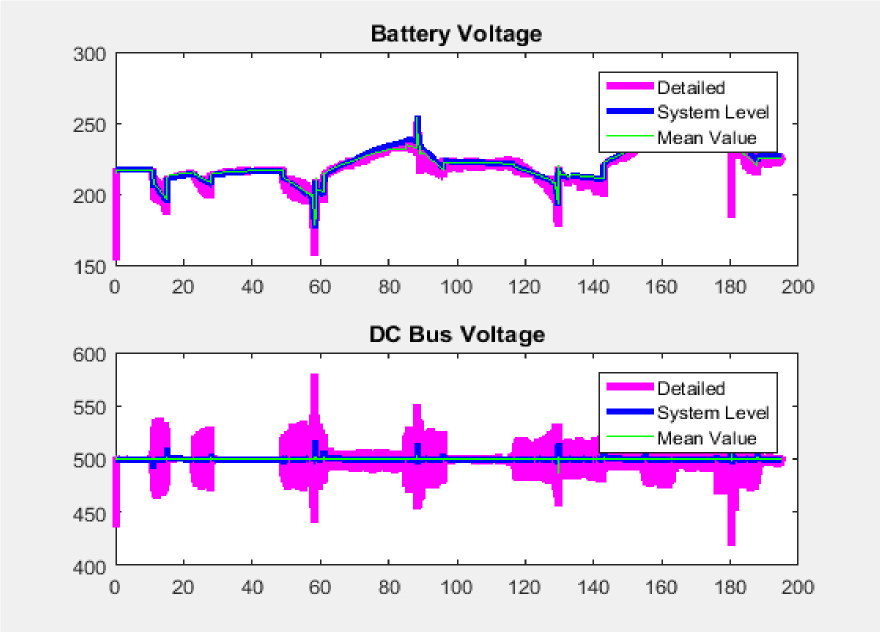

Figure 4.5. Voltages gathered from urban cycle.

Table 4.1. Simulation time for driver cycle fuel used.

Simulating urban driver cycle	Elapsed time	Fuel used	Fuel used/ Elapsed time
Simulation UDC1	18.0112 Sec.	0.047127 Liters	0.002616 L/S
Simulation UDC2	23.7715 Sec	0.10727 Liters	0.004512 L/S
Simulation UDC3	21.7814 Sec	0.098114 Liters	0.004504 L/S

Table 4.1. shows the simulating urban for each driver cycle and each driver cycle used fuel per elapsed time, when you run the simulation you can see the time and each drivers how much fuel used at urban driver cycle 1, urban driver cycle 2, and urban driver cycle 3.

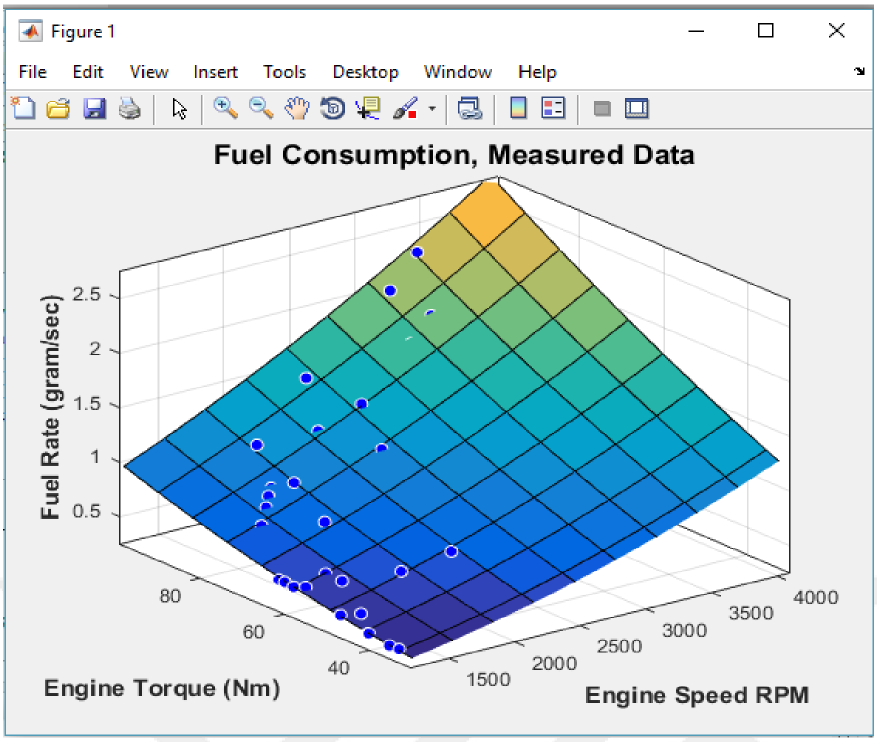

Figure 4.6. Fuel consumption data.

In the figure 4.6. shows the fuel consumption data, which is measured data fuel rate for engine. How a similar model we have utilized for simulation on the desktop, can be changed over to C code for organization attempting to equipment tuned in framework and different situations to utilize this half breed electric vehicle show for equipment in circle testing, it should reproduce progressively that mean simulating with a repaired solver utilizing Simscape nearby solvers enhancing reproduction execution idealize step simulation in Simscape you have the alternative of utilizing foxed up certain solvers locally on physical systems this implies utilizing understood solvers just where it's essential, to this point we have been simulating framework with variable advance solver, making your model more inclined to keep running continuously in Simscape, and in the figure 4.7. shown the vehicle speeds from urban cycle in detailed, system level, and mean value.

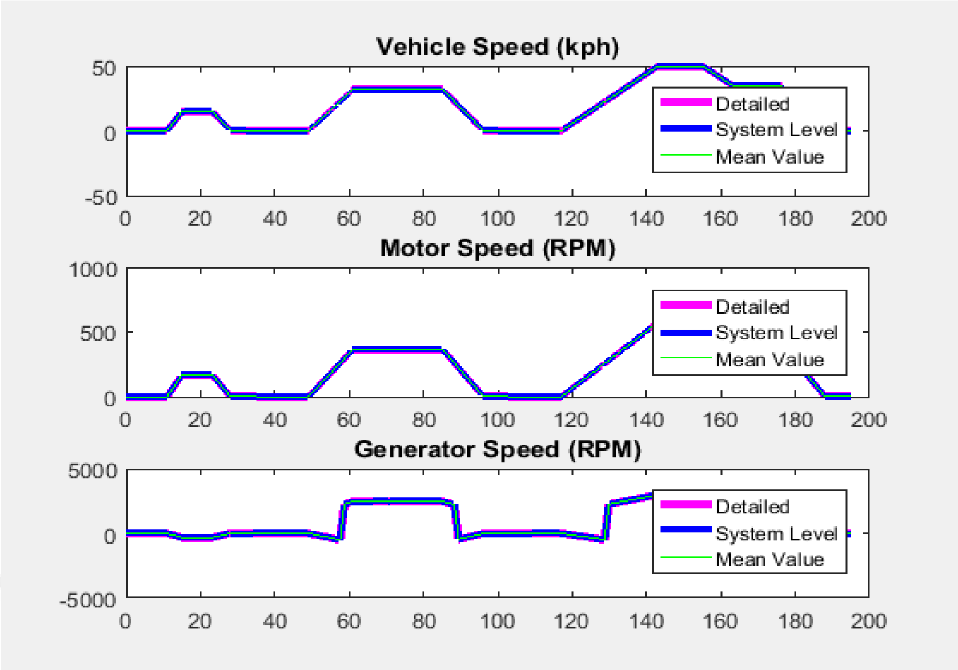

Figure 4.7. Vehicle speeds from urban cycle.

Table 4.2. Simulation time.

Configuration	Elapsed time	Simulation time	Simulation time/ Elapsed time
System BD V	4.7654 Sec.	195 Sec.	40.9201 Sec.
System BD V	7.2198 Sec.	400 Sec.	55.4033 Sec.
System BD V	6.7394 Sec.	400 Sec.	59.3524 Sec.

As shown in the table 4.2. you can see the result of configuration system and arrange solver for simulation, you can arrange a low a neighborhood solver for each physical system this empowers you to run distinctive physical systems an alternate example rates, so electrical system at higher rates and mechanical at bring down rates, again diminishing the quantity of calculations done per time steps. The essential advantage of this is to accelerate simulations where settled Epps hours are required like hardware in loop testing.

5. CONCLUSIONS

The Changing the scope of agent systems from real problem solving to virtual based tasks, the change leads area of multi-agent based simulations. However, the active and autonomous true world existences are mapped as agents which are firm in a participate, virtual and abstracted milieu. The agent-based human-in-the-loop simulation provides a natural description of real system by mapping real world entities to personally behaving agents such as traffic jam. Furthermore, captures the emergent event in a system, which results from the interaction of people such as social groups replicated by agent-based simulation. In the same manner, such systems may capture group actions that are enriched with individual attributes for reasoning and consideration.

All in all, agent-based human-in-the-loop simulation are tools that can catch combined and pragmatic aspects as traditional simulation systems. Nevertheless, they have a meaningful and developed level of detail on the person’s side. Flexibility is also achieved by a dynamic adaptation of simulated situation. For such systems, it is irrelevant on how simulation can be coupled as long as the agents can join together and interact with a particular environment model that influences the general complexity of a simulation. For additional freedom, the agents can be given a higher level of or the ability of rationality to change their reactions to occurring situation.

Via evolve this testbed and this broadened algorithm, we can gather practical driving information and precisely foresee driver conduct. This exploratory setup is one of a kind in that it enables us to gather information for the human-in-the-loop frameworks, while keeping up wellbeing measures and control of the circumference environment. By making a strong system we can drive the information gathering to the hunt out corner cases or rare occasions that regularly emerge in driving situations. By making an adaptable, setting mindful framework, the recognizable proof is constrained to locales that it has seen earlier yet is sufficiently adaptable to deal with differences in situations. This definition can be utilized as a part of a semi-autonomous system that can powerfully react to unverifiable human conducts.

Via utilizing this practical information and flexible algorithm, an exact and precise driver demonstrate can be produced that is custom fitted to an individual and usable in semi-autonomous systems and in driver conduct analyses. Future works incorporate including more settings, similar to evening driving, poor climate conditions, frosty streets, levels of activity, and so on.; looking at changed diversions and the subsequent variety in practices; and testing different control techniques while the driver is heading to check that the framework is insignificantly obtrusive and keeps up proper security edges. Specifically, actualizing and distinguishing parameters for the potentiality control structure will be investigated to check practicality and unwavering quality. We will likewise think about use in a genuine vehicle, through new, more sensible tests and by analyzing the connection between driving practices in a test system and in a real vehicle regarding this model, as has been considered here.

REFERENCES

[1] **L. Rothrock and S. Narayanan (eds.),** Human-in-the-Loop Simulations, DOI: 10.1007/978-0-85729-883-6_1, Springer-Verlag London Limited 2011.

[2] **D.-J. Kimand A. Behal,** ‘‘Human-in-the-loop control of an assistive robotic arm in unstructured environments for spinal cord injured users,’’ in Proc. 4th ACM/IEEE Int. Conf. HRI, Mar. 2009, pp. 285–286.

[3] **J. Y. C. Chen, M. J. Barnes, and M. Harper-Sciarini,** “Supervisory Control of Multiple Robots: Human Performance Issues and User-Interface Design,” IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews), vol. 41, no. 4, pp. 435-454, Jul. 2011.

[4] **Hou, Yunfei, et al.** "Simulation-based testing and evaluation tools for transportation cyber–physical systems." IEEE Transactions on Vehicular Technology 65.3 (2016): 1098-1108.

[5] **Dimitrov, Velin, and Taşkın Padır.** "A shared control architecture for human-in-the-loop robotics applications." The 23rd IEEE International Symposium on Robot and Human Interactive Communication. IEEE, 2014.

[6] **Zhu, Y.; Chen, Y.; Tian, G.** A Four-Step Method to Design an Energy Management Strategy for Hybrid Vehicle. In Proceedings of the 2004 American Control Conference, Boston, MA, USA, 30 June–2 July 2004.

[7] **Katherine Driggs Ampbell, Ruzena Bajcsy.** Experimental design for Human-in-the-loop driving simulations. Technical report no. UCB/EECS-59, May 11, 2015.

[8] **Rothrock, Ling, and S. Narayanan.** Human-in-the-loop simulations. Springer, 2011.

[9] **J. Wang and M. Lewis,** “Human control for cooperating robot teams,” Proceeding of the ACM/IEEE international conference on Human-robot interaction, 2007, pp. 9-16.

[10] **G. Goodwin, M. Seron and J. Dona,** Constrained Control and Estimation: An Optimization Approach, Springer, Berlin, 2010.

[11] **M. Fischer and J. Werneke,** The new time-variant motion cueing algorithm for the DLR Dynamic Driving Simulator, DSC Europe, Monaco, 2008.

[12] **G. Schirner, D. Erdogmus, K. Chowdhury, and T. Padir,** “The future of human-in-the-loop cyber-physical systems,” Computer, vol. PP, no. 99, pp. 1–1, 2012.

[13] **C. Rasmussen, K. Yuvraj, R. Vallett, K. Sohn, and P. Oh,** “Towards functional labeling of utility vehicle point clouds for humanoid driving,” in Technologies for Practical Robot Applications (TePRA), 2013 IEEE International Conference on, April 2013, pp. 1–6.

[14] **R. Desmond, M. Dickerman, J. Fleming, D. Sinyukov, J. Schaufeld, and T. Padir,** “Development of modular sensors for semi-autonomous wheelchairs,” in Technologies for Practical Robot Applications (TePRA), 2013 IEEE International Conference on, April 2013, pp. 1–6.

[15] **Drop, F.M., Pool, D.M., Damveld, H.J., van Paassen, M.M., Mulder, M.,** "Identification of the Feed Forward Component in Manual Control with Predictable Target Signals," Cybernetics, IEEE Trans. on, vol.43, no. 6, pp.1936,1949, 2013.

[16] **Rahimi-Eichi, Habiballah, et al.** "Battery management system: an overview of its application in the smart grid and electric vehicles." IEEE Industrial Electronics Magazine 7.2 (2013): 4-16.

[17] **Jiang, Zhenhua.** "Agent-based power sharing scheme for active hybrid power sources." Journal of Power Sources 177.1 (2008): 231-238.

[18] **Rovatsos, Michael, George Vouros, and Vicente Julian, eds.** Multi-Agent Systems and Agreement Technologies: 13th European Conference, EUMAS 2015, and Third International Conference, AT 2015, Athens, Greece, December 17-18, 2015, Revised Selected Papers. Vol. 9571. Springer, 2016.

[19] **J. Z. Kolter and J. Ferreira,** ‘‘A large-scale study on predicting and contextualizing building energy usage,’’ in Proc. AAAI, 2011, pp. 1340–1356.

[20] **A. Marchiori and Q. Han,** ‘‘Distributed wireless control for building energy management,’’ in Proc. BuildSys, 2010, pp. 37–42.

[21] **M. Micire et al.,** “Design and validation of two handed multi-touch tabletop controllers for robot teleoperation,” in Proceedings of the 15th international conference on Intelligent user interfaces IUI 11, 2011, pp. 145-154.

[22] **D. Singh and L. Padgham. OpenSim:** A framework for integrating agent-based models and simulation components. In Frontiers in Artificial Intelligence and Applications-Volume 263: ECAI 2014, pages 837–842. IOS Press, 2014.

[23] **Fiksel, Joseph.** "Sustainability and resilience: toward a systems approach." Sustainability: Science, Practice, & Policy 2.2 (2006): 19-45.

[24] **Nance, R. E., and R. G. Sargent.** 2002. Perspectives on the evolution of simulation. Operations Research 50(1): 161–172.

[25] **Bradley, Justin M., and Ella M. Atkins.** "Optimization and control of cyber-physical vehicle systems." Sensors 15.9 (2015): 23020-23049.

[26] **Bayindir, Kamil Çağatay, Mehmet Ali Gözüküçük, and Ahmet Teke.** "A comprehensive overview of hybrid electric vehicle: Powertrain configurations, power train control techniques and electronic control units." Energy Conversion and Management 52.2 (2011): 1305-1313.

[27] **Lam, Chi-Pang, and S. Shankar Sastry.** "A pomdp framework for the human-in-the-loop system." 53rd IEEE Conference on Decision and Control. IEEE, 2014.

[28] **Puch, Stefan, et al.** "Rapid virtual–human–in–the–loop simulation with the high-level architecture." Proc. of Summer Computer Simulation Conference (SCSC 2012). The Society for Modeling & Simulation Int., Curran Associates, Inc., Genua. Vol. 44. 2012.

[29] **R. Rönnquist.** The goal oriented teams (gorite) framework. In Programming Multi-Agent Systems, pages 27–41. Springer, 2008.

[30] **Van Overloop, P. J., et al.** "Human-in-the-loop model predictive control of an irrigation canal." IEEE Control Systems Magazine 35.4 (2015): 19-29.

[31] **I. Sakellariou, P. Kefalas, and I. Stamatopoulou.** Enhancing NetLogo to simulate BDI communicating agents. In Artificial Intelligence: Theories, Models and Applications, pages 263– 275. Springer, 2008.

[32] **Poria Fajri, N Nima Lotfi, Mehdi Ferdowsi, et al,** "Development of an educational small scale hybrid electric vehcile(hev) setup," Electric Vehicle Conference (IEVC), 2013 IEEE International, 23-25 Oct. 2013, pp.1-6.

[33] **A. Grignard, P. Taillandier, B. Gaudou, D. Vo, N. Huynh, and A. Drogoul.** GAMA 1.6: Advancing the art of complex agent-based modeling and simulation. In PRIMA 2013: Princ. and Practice of Multi-Agent Systems, volume 8291 of LNCS, pages 117–131. Springer, 2013.

[34] **Bassem Hassan, Jan Berssenbrügge, Imad Al Qaisi, et al,** "Reconfigurable Driving Simulator for Testing and Training of Advanced Driver Assistance Systems," IEEE, 2013, pp.337-339.

[35] **N. Howden, R. Rönnquist, A. Hodgson, and A. Lucas.** JACK intelligent agents-summary of an agent infrastructure. In 5th International conference on autonomous agents, 2001.

[36] **J. Spinozzi, Cyth Systems,** "A Suite of National Instruments Tools for Risk-Free Control System Development of a Hybrid-Electric Vehicle," Proceeding of the 2006 American Control Conference Minneapolis, Minnesota, USA, June 14-16, 2006, pp.1401-1405.

[37] **Julian Schindler, Christian Harms, Ulf Noyer, et al,** "JDVE: A Joint Driver-Vehicle-Environment Platform for the Development and Accelerated Testing of Automotive Assistance and Automation System," Human Modelling in Assisted Transportation, 2011, pp.233- 240.

[38] **E. Barrera, M. Ruiz, S. López, et al,** "PXI-Based Architecture for Real- Time Data Acquisition and Distributed Dynamic Data Processing," Nuclear Science, IEEE Transactions, vol.53(3), June 2006, pp.923-926.

[39] **Tianlei Zhang, Jeremiah Shepherd, Jijun Tang, et al.** A gaming environment approach to analysis energy storage for electric/hybrid vehicle[C]. Clean Electrical Power (ICCEP), 2011International Conference on, Ischia, Italy. Piscataway: IEEE Press, 2011, pp.400- 406.

[40] **Michelle Menard,** "Game Development with Unity" Course Technology PTR, 2011, pp.0-352.

[41] **M. Balmer, M. Rieser, K. Meister, D. Charypar, N. Lefebvre, K. Nagel, and K. Axhausen. Matsim-t**: Architecture and simulation times. Multi-Agent Systems for Traffic and Transportation Engineering, pages 57–78, 2009.

[42] **P. Taillandier, O. Therond, and B. Gaudou.** A new BDI agent architecture based on the belief theory. application to the modelling of cropping plan decision-making. In iEMSs, 2012.

[43] **V. M. Le, B. Gaudou, P. Taillandier, and D. A. Vo.** A new BDI architecture to formalize cognitive agent behaviors into simulations. In KES-AMSTA, volume 252 of Frontiers in Artificial Intelligence and Applications, pages 395–403. IOS Press, 2013.

[44] **L. M. Bergasa, J. Nuevo, M. A. Sotelo, R. Barea, and M. E. Lopez.** Real-Time System for Monitoring Driver Vigilance. IEEE Transactions on Intelligent Transportation Systems, 7(1):63{77, Mar. 2006.

[45] **K. Driggs-Campbell, V. Shia, R. Vasudevan, F. Borrelli, and R. Bajcsy.** Probabilistic driver models for semiautonomous vehicles. Digital Signal Processing for In-Vehicle Systems, October 2013.

[46] **H. Berndt, S. Wender, and K. Dietmayer.** Driver braking behavior during intersection approaches and implications for warning strategies for driver assistant systems. In IEEE Intelligent Vehicles Symposium, pages 245{251, June 2007.

[47] **Steve Miller. The MathWorks, Inc.** Hybrid-Electric Vehicle Modelling and Simulation 2014- 2016.

[48] **A. Doshi, B. T. Morris, and M. M. Trivedi.** On-Road Prediction of Driver's Intent with Multimodal Sensory Cues. IEEE Pervasive Computing, 10(3):22 {34, Sept. 2011.

[49] **V. Shia, Y. Gao, R. Vasudevan, K. Campbell, T. Lin, F. Borrelli, and R. Bajcsy.** Semiautonomous vehicular control using driver modeling. IEEE Transactions on Intelligent Transportation Systems, PP (99):1-14, 2014.

[50] **K. Driggs-Campbell, V. Shia, and R. Bajcsy.** Improved driver modeling for human-in-the-loop control. In 2015 IEEE International Conference on Robotics and Automation, May 2015.

[51] **Gopalakrishna, A. K., T. Ozcelebi, J. J. Lukkien, and A. Liotta.** “Relevance in cyber-physical systems with human-in-the-loop”. Concurrency and Computation: Practice and Experience vol. 29 (3), pp. e3827. 2017, 2.

[52] **Gao, W.; Porandla, S.K.** Design Optimization of a Parallel Hybrid Electric Powertrain. In Proceedings of 2005 IEEE Conference on Vehicle Power and Propulsion, Mississippi, MS, USA, 7–9 September 2005.

[53] **Hui, S.** Multi-objective optimization for hydraulic hybrid vehicle based on adaptive simulated annealing genetic algorithm. J. Eng. Appl. Artif. Intell. 2010, 23, 27–33.

[54] **Wang, Z.; Huang, B.; Li, W.; Xu, Y.** Particle Swarm Optimization for Operational Parameters of Series Hybrid Electric Vehicle. In Proceedings of IEEE International Conference on Robotics and Biomimetics, Kunming, China, 17–20 December 2006.

[55] **Wu, J.; Zhang, C.H.; Cui, N.X.** PSO Algorithm-Based Parameter Optimization for HEV Powertrain and its Control Strategy. Int. J. Automot. Technol. 2008, 9, 53–69.

[56] **Z. Yang, F. Shang, I. Brown and M. Krishnamurthy,** "Comparative Study of Interior Permanent Magnet, Induction, and Switched Reluctance Motor Drives for EV and HEV Applications," IEEE Transactions on Transportation Electrification, vol. 1, no. 3, pp. 245-254, October 2015.

[57] **Massey, Sanjai,** "Modelling, Simulation and control of hybrid electric vehicle drive while minimizing energy input requirements using optimized gear ratios", Open Access Master's Report, Michigan Technological University, 2016.

[58] **Larsen, P. G., J. Fitzgerald, J. Woodcock, P. Fritzson, J. Brauer, C. Kleijn, T. Lecomte, M. Pfeil, O. Green, S. Basagiannis, and A. Sadovykh.** “Integrated tool chain for model-based design of Cyber-Physical Systems: The INTO-CPS project”. In 2016 2nd International Workshop on Modelling, Analysis, and Control of Complex CPS (CPS Data), pp. 1–6, IEEE. 2016, 4.

[59] **Nunes, D. S., P. Zhang, and J. Sa Silva.** “A Survey on Human-in-the-Loop Applications Towards an Internet of All”. IEEE Communication surveys & tutorials vol. 17 (2). 2015.

CURRICULUM VITA

Karwan Hoshyar Khalid Khoshnaw

karwan.cu.08@gmail.com

Nationality:	Iraq
Place of birth:	Sulaymani, Ranya
Date of birth:	12 / 02 / 1983
Marital status:	Married

EDUCATION

03/ 2015 – 01/ 2018 MSc (Master of Science, Computer Engineering), FIRAT University, Elaziğ, Turkey.

09/ 2008 – 07/ 2012 BSc (Bachelor of Science, Computer Science) CIHAN University, Iraq.

10/ 2004 – 10/ 2006 Diploma of Mechanical/ Refrigeration and Air Condition, Erbil Technical Institute.

08/ 2004 High School, RZGARY High School Erbil, Iraq.

02/ 2014 Installing and Configuration Windows Server 2012 (20410) certificate, Iraq Microsoft partner.

02/ 2014 Networking Fundamentals (40366), Iraq Microsoft partner.